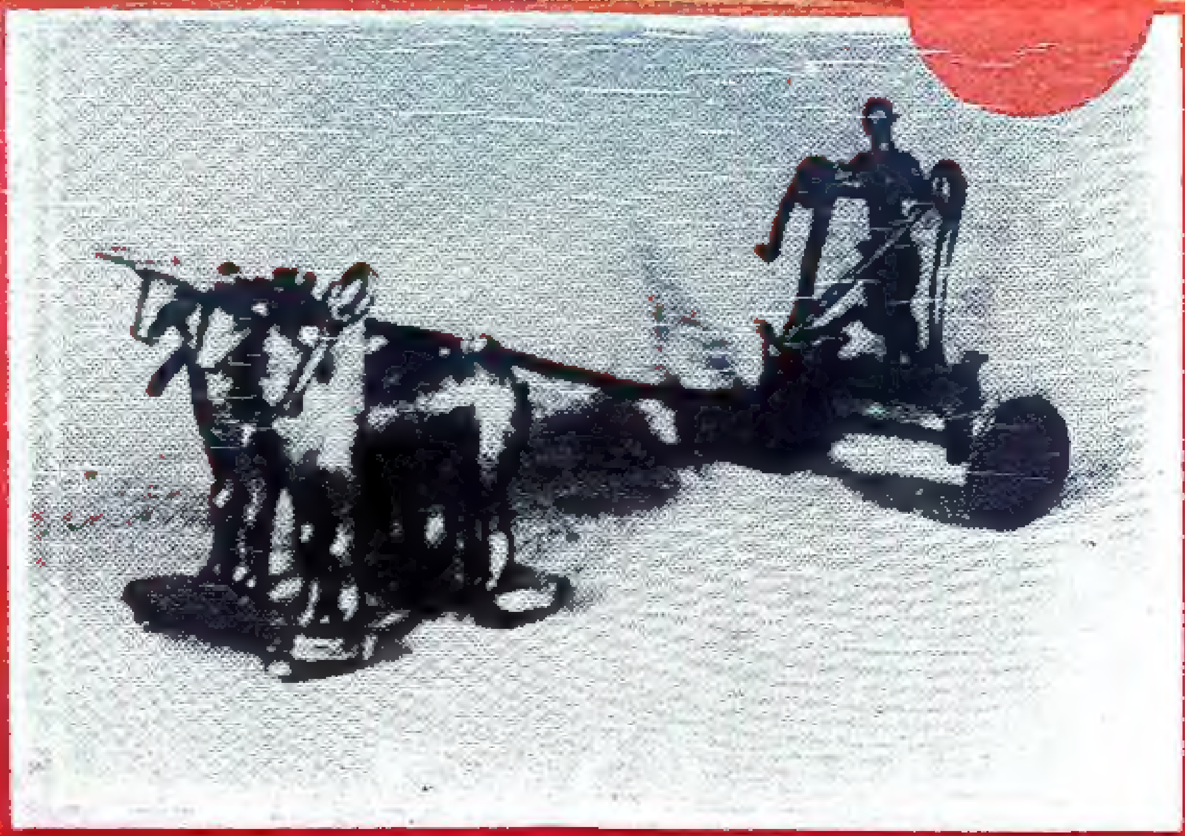
THE DAWN OF TECHNOLOGY IN INDIAN PROTOHISTORY



NUPUR DASGUPTA

About the Book

This book offers a reading of the early history of technological advancement in the Indian subcontinent from a historical view point. The time covered in the book spans the period from the first days of settled human society to the advent of the Iron Age. Three major aspects of technological break through have been surveyed : animal husbandry, agriculture and metallurgy. These three were the main determinants of the course of development that took human experience to the levels of early civilization. In treating technological development a socio-economic frame work of analysis has been adopted. One of the major intentions of this work is to project the essential link between social and technological developments and the necessity of taking a social angle when studying the history of technology. Instead of dealing with the data on technology as separate from the general evidences they were collectively analysed in the context of social existence.

The author has offered some new planations explanations for the problem areas in Indian Protohistory. More importantly, the work reveals the necessity to treat the protohistory of India at microlevels in order to make significant contributions in analysing social progress. The author has highlighted the plurality of social existence evident not only in the form of distinct cultural contexts but also within the macrocosms of such homogeneous contexts like the Harappan Culture and other chalcolithic cultures throughout the temporal and spatial span covered.

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About the Author

Nupur Dasgupta teaches history in the History Department, Jadavpur University. She has specialised in the early history of India. The area of her interest covers the social history of science and technology, gender issues, and folk culture in early India. She has published papers on her chosen field of research and is currently engaged in further work on the above subjects.

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The Chariot from Daimabad Hoard
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The Dawn of Technology in Indian Protohistory

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Nupur Dasgupta

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Dedicated to

In Memory of my father Dr. B.M. Bhattacharya, who is no more and to Dr. Sachindra Kumar Maity and Sri Pijus Dasgupta whose constant guidance and support urge me on.

Preface

This book is the product of almost a decade of research. Originally a doctoral thesis, the subject has stayed with me ever since. It has been added to and modified in the last few years. New evidences and new perceptions have enlarged its scope. Time and again, my understanding of the significance of technological advancement in the greater sphere of social growth had set me planing for a more mature work for publication. Fortunately, the recent interest taken by scholars in the history of science and technology has provided the much required courage and confidence in doing this.

This work contains an honest delineation of the available archaeological and literary data on the subject as well as reports of scientific analysis of some of the archaeological findings. The interpretation of these data has taken the line of a historical perspective on the growth of human societies and the various complex relationships existing between technological advancement and economic growth in each given context. In doing this the work faced a lot of unavoidable gaps in knowledge. As a result, a lot is left to hypothesis, a lot more for future work, when hopefully, these gaps would be narrowed down. I have often gone for setting models based on complete pictures of a cultural context, wherever achieved, and used such models for understanding the corresponding cultures with similar or relative parameters. This is not a fool proof method but resorted to as an exercise in bringing hypothesis closer to actual realities.

Questions, such as, how man came to handle the natural resources around him for his own use and how from the stage of rudimentary, individual attempts at production he graduated to general, organised, technology-aided economies are answered by simple general knowledge. But when such questions attain specificity concerning individual cultures in given social contexts, the answers are difficult to arrive at. In this work an attempt has been made to read the data from all possible angles of perception. In spite of this there is scope for addtions and modifications for the future. The work has been left open for such modifications wherever the data falls short of fuller comprehensibility. For any student of history, the interest of the subject does not only lie in its significance and relevance in the

current trend of reading societies of the past but also in the ready changeability of perspectives and database on the subject which calls for recording of data and analysis at every stage of understanding.

I take this opportunity to express my heart felt gratitude and feeling of indebtedness to my teacher - preceptor, Dr. Schindra Kumar Maity. Without him this work would not have seen the light of the day. I am extremely grateful to Dr. R.C. Gaur, retired professor of the Aligarh Muslim University, who kindly allowed me the privilege of spending some memorable times at the excavation camp at Fatehpur Sikri. He gave most valuable suggestions that have helped me considerably in my approach to the subject of my research. I also express my sincerest thanks to professor M.K. Dhavalikar, now retired from the Deccan College Post Graduate and Research Institute, Pune, for his illuminating suggestions which went a long way in enriching my perceptions on the subject.

I would also like to express my indebtedness to my colleagues at the History Department, Jadavpur University who never failed to proffer help whenever sought. I must be thankful that in Mr. Sankar Bhattacharya and Prasanta Bhattacharya of Punthi Pustak. I have the most sincere and diligent publishers whose constant solicity has helped in many ways.

I take this opportunity to thank my mother-in-law whose abiding interest and support went a long way to accomplish this work. I am ever grateful to Soham, Swayampravo and Neelapravo who have borne with patience the pain of a wife and mother beaten by the book-bug for a long enough time. Lastly, no amount of thanks giving can equal the indebtedness I feel to a mother whose contribution does not begin and end with this work.

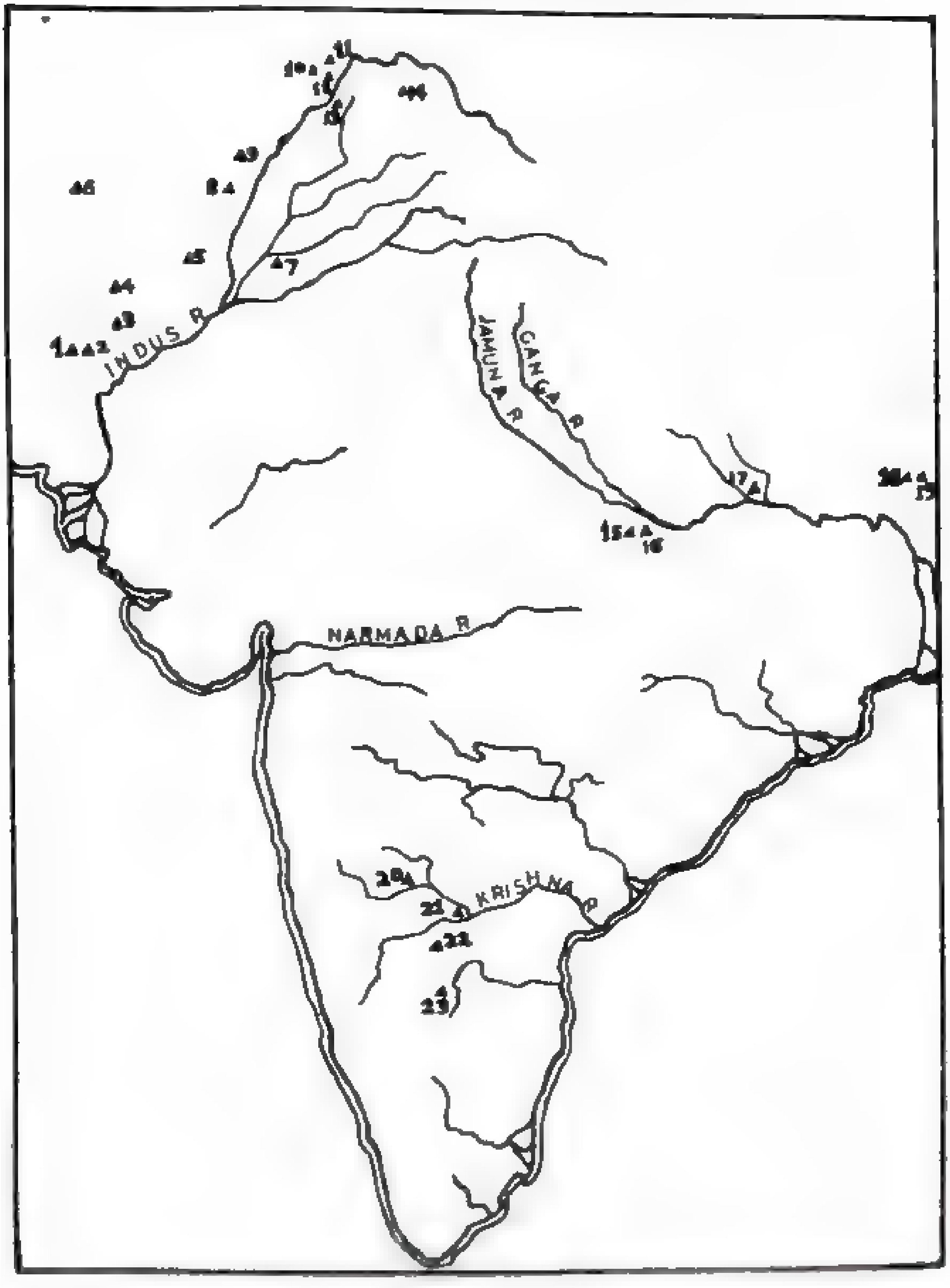
Calcutta, 1997 **Nupur Dasgupta**

ABBREVIATIONS

AĀ	... ...	Aitareya Āraṇyaka
AB	... ...	Aitareya Brāhmaṇa
Āp. DS	... ...	Āpastamba Dharma Sūtra
Āp. GS	... ...	Āpastamba Grihya Sūtra
Āp. SS	... ...	Āpastamba Śrauta Sūtra
Āś. GS	... ...	Āśvalāyana Gṛhya Sūtra
AV	... ...	Atharva Veda
BDS	... ...	Baudhayāna Dharma Sūtra
BSS	... ...	Bhāradvāja Śrauta Sūtra
BU	... ...	Bṛhadāraṇyaka Upaniṣad
CU	... ...	Chāndogya Upaniṣad
GDS	... ...	Gautam Dharma Sūtra
KS	... ...	Kāthaka Saṃhitā
Kau. S	... ...	Kausika Sūtra
MASCA	... ...	Museum and Applied Science Centre for Archaeology
MS	... ...	Maitrāyanī Saṃhitā
MU	... ...	Maitrāyania Upaniṣad
NBPW	... ...	Northern Black Polished Ware
OCP	... ...	Ochre Coloured Pottery
PGS	... ...	Pāraskara Gṛihya Sūtra
PGW	... ...	Painted Gray Ware
RV	... ...	Ṛg Veda
SA	... ...	Śaṅkhāyana Āraṇyaka
SB	... ...	Śatapatha Brāhmaṇa
TB	... ...	Taittiriya Brāhmana
VS	... ...	Vājasanayi Saṃhitā
VDS	... ...	Vaśiṣṭha Dharma Sūtra

CONTENTS

THE NEOLITHIC SITES



MAP · I

KEY

1 SIAH DAMB
2 ANJIRA
3 MEHRGARH
4 KILI GHUL MOHAMMAD
5 RANA GHUNDAI
6 MUNDIGAK
7 JALILPUR
8 GUMLA
9 LEWAN
10 GHALIGHAI
11 ALIGRAMA
12 LOEBANR
13 SARAI KHOLA
14 BURZAHOM
15 MAHAGARA
16 KOLDIHWA
17 CHIRAND
18 DEOJALI HADING
19 SARUTARU
20 KODEKAL
21 UTNUR
22 KUPGAL
23 PALAVOY

INTRODUCTION

The progress of human civilization from the Stone Age to the Space Age has been marked, at each step, by innovations and technological leap-forwards that brought forth major changes in the economy. To the modern man, who can achieve a 'Green Revolution' easily and harness nuclear power for various projects or dream of a space colony, the first stages of innovations and developments may occur quite insignificant by comparison. However, the story of development of the techniques of production and the production economy and the relation of these to the over-all cultural changes from the earliest days would provide us with a correct perspective for understanding the trends of the developments of human civilization. Such studies are not mere documentations but provide some premises for analyses and inferences in the modern context, even from a futuristic angle.

From the beginnings of human history, it is man's activities of production that set him apart from the other animals. Man's earliest interference in the natural world was unconscious, arising out of the primeval urge for survival. In this he was not very different from the animals. But the real take off took place when man consicously began to exploit the natural resources around him. The organised exploitation of nature led to man's first attempts at production — the production in connection with food. With the 'Neolithic Revolution', as defined by Gordon Childe,[1] the human society stepped upon the threshold of production economy. Man became a superior species capable of regulating and producing for his own needs and demands. First this was in relation to food. Gradually, as societies developed, more varied and higher needs arose which had to be met. The birth of handicrafts took place. The production of food and handicrafts constituted the basic factors that began to determine the course of economy and also contributed to the over-all development of human history. The study of these factors in the earliest developmental stages and their

interaction with the total economic cultural advancement are of immense interest.

The treatise attempts to analyse the background, conditions and consequences of the developments of three basic categories of production technology, viz., animal husbandry, agriculture and metallurgy in the Indian subcontinent. We have chosen our period to cover the span from the third millennium B.C. to the sixth century B.C. This time rance enebles us to note the progress from the neolithic to the iron age.

Technology is difined as — "the practice, description and terminology of any or all of the applied sciences which have practical value and/or industrial use."(The Wordsworth Dictionary of Science and Technology, Wordsworth Editions Ltd., printed in Denmark, 1995, p. 888). The definition itself covers a wide territory taking in the broader application of technology in the progress of human society. We have tried to locate our subject in its exact background and context. Hence the study necessarily covers aspects of each social context that have been encountered in our scope with a view to investigating the parameters of technological advancement. We have come across wide variations even within each so-called culturally homogeneous eontexts that set us thinking on lines of plurality of cultures. However,basic characteristics could be discerned in some respects which present a pattern. This strengthens the idea that a kind of social regulation worked behind the emergence of commonality and homogeneous cultural enclaves like the 'Harappan Society'. Technology in fact was studied not only for itself but also to analyse both the factors reflecting plurality as well as those helping compose overall homogeneity in given contexts.

Our study is inherently associated with economy, often at micro levels. The symbiosis between technology and economy is one of the major concersn here. We do not engage in a dissociated history of technology plucked out of its social context. When a society, for example, is seen to be moving out from its original habitional area to new lands, we have tried to determine the requirements of the society

concerned in terms of production technology. demography as well as ecology. Ecological factors are of major concern as they control the conditions of growth of technology and provide the basic elements for handling.

The choice of animal husbandry and agriculture comes from a desire to rightly locate these two very fundamental technologies in the anthology of social development. The processes of plant and animal domestication called for a mastering of the skills of handling the animal and plant species and the nature at large. They included species identification, selection, breeding, interbreeding for quality and quantity, training of animals for physical labor. A knowledge about the biological and botinical characteristics and requirements are also required. Finally, these developments within technology entailed a regular concurrence with the requirements of the human society.

As to the handling of metals there is perhaps no need to emphasise the importance of the subject. The metals gave men an edge over other animals. This was a new raw material which produced stronger and more durable tools and weapons than stone, wood or bone. The malleability and reducability of metals gave a wide range of choice as to shapes and sizes and faciliated recycling of metals and recurrent use. The metals vastly widened the scope for exploiting natural resources and set a milestone of immense development. The know-how and infrastructure involved in the above categories of technology were associated with a great deal of socio-economic organisation. This was true especially for the metal works. This study in its humble way, attempts to work out a perspective which will offer the dawn of technology in this subcontenent a fitting reckoning.

The work is at a redimentary stage in the absence of an accepted version of desiphered Harappan script, but more because of the dearth of scientific analyses of the artifacts. The author takes this opportunity to draw the attention of experts and scholars to this lacunae in out knowledge. An unveiling of the great mystrey awaits us.

The reports of the archaeological exploration and excavations of the numerous sites in our subcontinent have

formed the chief source of information for our study. Indeed, they are the only primary source for the time before the Vedic Age. The Vedic literature provide a mine of information regarding the period between C 1500 B.C. and the sixth century B.C.

Besides these primary sources, the works of some scholars on the history of the period under study have been of great value to us. Here we may mention the works of Walter A. Fairservis[2] which have provided interesting insights into the nature of the Harappan Civilization. F.R. Allchin and B. Allchin's works on the neolithic ash-mound sites of South India[3] have proved to be extremely valuable for our study. K. R. Alur's study on the osteological evidences[4] are invaluable and has given great support to our study. L.S. Lesnik's study of the conditions for agriculture in the Harappan context[5] has been extremely informative.

Vishnu-Mittre[6] and K.A. Chowdhury[7] have provided the students of Indian protohistory with very valuable informations regarding the agricultural economy which we have heavily drawn upon. M.S. Randhawa has also done work on the history of agriculture in India in three volumes, covering the ancient, medieval and modern periods.[8] However the work is more descriptive than analytical.

In the field of metallurgy, C.C. Lamberg-Karlovsky's analysis on the evolution of the stages of metallurgy[9] has been of great value to us. D.P. Agrawal's work on the Copper-Bronze metallurgy[10] has been of substantial help. K.T.M. Hedge's analytical studies on chalcolithic metal repertoire from some sites[11] as well as his findings and theories regarding the iron artifacts and other evidences from Dhatwa[12] provide extremely interesting hypotheses regarding the copper and iron metallurgical processes likely to be practised in India in the early days.

R.C. Agrawala's works have provided sound and extremely significant theories regarding the source of copper-ore and objects for the 'Indus and Indus-related Cultures.[13] They have opened up new vistas for an understanding of the scenario of the Copper-bronze Age in India. R.C. Gaur has also provided us with interesting theory as to the origin of

the OCP folks and the independent character of the Copper-Hoards industry.[14]

N.R. Banerjee's detailed work on the Iron Age in India provide a lot of valuable information regarding the first appearance of iron and iron technology at many of the excavated sites and the theories of the diffusion of iron metallurgy in India.[15] Since then newer informations on these lines have been available which we have sought to cover and analyse from the view point of the origin and role of iron metallurgy in India. The same is true of the work of D.P. Agrawal on the Copper-Bronze Age.

The recent contribution of D.K. Chakrabarti and nayanjot Lahiri[16] as well as the first author's treatise on iron[17] in India are both of great value. However, their attempts at dealing with ethnographic data is ridden with the risk of over-presumption just as they themselves have pointed out the risk of over-simplification in case of drawing mechanical correlations between archaeology and technology on the one hand and ecology on the other. Our observation is that both such attempts are noteworthy developments in studying ancient societies. The risk should not deter us from observing a comprehensive growth in its varied manifestations, but it should check us from drawing mechanical conclusions. More importantly, while the above works have dealt deeply in chemical and metallographic reports made by experts, they have not attemped to locate the significance of metal technology in the multi-dimensional and multi regional development that took place in their canvas.

These works have been of immense help for our study. We acknowledge our indebtedness to all the scholars mentioned above. At the same time we beg to add that neither the aforesaid works nor any others till date within our knowledge have exactly the same scope and approach that our study has taken up. The necessity of such studies as these have already been discussed above. Here we may only add that Amita Ray and D.K. Chakrabarti's feelings as reflected in an article regarding the importance of such studies,[18] at least as far as agriculture and animal husbandry are concerned, have provided inspiration to us in taking up the subject.

In the course of our study, we have repeatedly seen how man through his productive activities have given the direction to all-round cultural development, in the broad sense of the term. As we shall see, neither the urban Harappan Culture nor the historic Ganges Valley urbanisation can be truly appreciated and analysed without an understanding of the production technology and economy that lay at the base of these historic developments. Among these, the prime importance of the agricultural economy and the role of the metal industry cannot be over looked. In the protohistoric context wherever we have noted the conditions indicating a possible flourish in the agricultural economy we could discern a social readiness awaiting further technological and economic advancements and we do not have to look far for the beginnings of an urban environment. In the context of the Harappan civilization the workings of the primary productive units operating in the economy supported the growth of urban settlements in the Indus Valley, Western Punjab, Saurashtra and northern Rajasthan. All of these cannot be explained by the theories of inter-regional trade connections with external cultures. It is imperative, therefore, to sift through the available evidences to note what technical and operational developments took place within the production sector. Likewise a perusal of the story of the development of the specialised techniques of metal handling would help us enormously to take stock of the overall picture of economic and technological advancement.

The general slowing down of cultural progress into a trickle in the Late Harappan context raises a number of questions like, how far this was this recession due to the shift in the geographical locale, affecting production operations; how far the climatic and ecological factors can be held responsible ; and even, how far is the lacuna in evidences responsible for the dismal picture of decay. The picture presented by the evidences on primary production and especially metal artifacts give us a few pointers to this riddle. In the same vein of study, it is also important to look into the conditions of the primary units of production economy in the contexts of the lesser chalcolithic cultures in

the Indian subcontinent. This allows us to make certain comparisons keeping in mind the ecological and temporal differences. At each of the chalcolithic contexts in Rajasthan, Malwa, Maharashtra and southern or eastern India the variables in environs set the ball of progress running in different directions. The overall homogeneity in say, crop selection or the domestication of cattle and even metal tool typology covering geographical regions however do not account for the total gamut of techno-social interactions at micro-levels. Hence this study necessarily deals in the details of each culture and within each culture.

The Vedic evidences supplementing the archaeological findings from the iron age enhance our understanding of the historical process of social progress in the context. The full-scale operations of the techniques of production could now be understood in terms of nomenclature and institutionalisation of technical knowledge by man. The provision of social sanction to that knowledge through ritualisation of the processes of operation could be discerned. The *Sītāyajña, lāṅgalamyajña, aśvamedha*, the Rg Vedic passage comparing the process of purifying the human soul with that of smelting of metals, indicate such institutionalisation. The Vedic literature reflect a mentality, a human attempt at comprehending, utilising and mustering the forces of nature and society in the context of upper-middle Ganga valley from the late second millennium to the mid first millennium. The ambience for further socio-economic developments heralding the state-society has been created. We leave the scene at precisely this juncture after recording the preceding developments that set the stage. We have tried to analyse at the end of each chapter the significance of the interactive technological and social criteria in the story of these developments.

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CHAPTER – I

ANIMAL HUSBANDRY

Domestication of animals and plants, the pre-condition of husbandry, is one of the major landmarks in the history of human civilisation. The process of domestication of plants and animals is considered one of the most important transitions in human technological and cultural development. Man's attempts at domestication of plants and animals led to his advancement from the hunting-food-gathering stage to the higher economic stage of husbandry or food production, instituting a great leap forward on the road of civilisation. In the words of V. Gordon Childe this process indicated a very vital stage in technological development which he expressed as the "Neolithic Revolution".[1] The term, however, as Gordon Childe pointed out, "does not imply a single catastrophic change".[2] He mentions that like the industrial Revolution, the 'Neolithic Revolution' was also the culmination of a gradual process. There can be no doubt that this process had a long history, extending perhaps over several thousand years. The earliest evidences for domestication that can be cited in the history of man-kind are but results of long-continued efforts in this direction. The transitions brought about by the 'Neolithic Revolution', as those that followed the Industrial Revolution in the modern context, represent fundamental alterations both in man's relationship with the physical environment and in his relationship with his fellowmen. The first attempts at domestication of plants and animals began at an early date. The evidences begin to come at a period somewhere around C 10th millennium B.C.[3]

The process of husbandry is an extremely complicated

one, involving a special interference on the part of human beings in the life and ways of both plants and animals. By domesticating plants, man gained control over the primary food source, for himself as well as animals. By domesticating animals, he gained control over living organism that fed upon the plants and concentrated the plant-energy in a considerable manner in the form of animal protein. Thus man begins to tap both primary and secondary sources of food in a systematic manner once he begins to occupy the culture of plant and animal rearing and storing and ushers in the stage of husbandry. Thus begins the first attempts of man at food production, the basis of all further economic and cultural developments in the human society. The domestication of plants and animals, the mainspring of food production ensures security in food and leads naturally to an increase in human population, this having a direct effect on the demographic situation as well as the cultural evolution of human society. Hence, as R.A. Watson and P.J. Watson comment, domestication of plants and animals is the foundation of civilisation.[4] Although animal and plant husbandry go hand in hand in human cultural history, we shall, for the convenience of our study, deal with these aspects separately. Since attempts at animal domestication began slightly earlier than plant domestication, we shall first make a review of the former.

In this respect we find that hunting has been the oldest occupation of man along with the collection of foods. With domestication of animals man began to interfere in the animal world around him in an organised manner with a specific logic working behind it. S. Bokonyi states that, although man has been hunting some animal species and driving them out from their shelters from a very early date, "domestication is an interference of a quite different kind".[5] According to him, the earliest attempts at animal husbandry were certainly motivated by the realisation of the need for securing living animal protein reserve for men.[6] The animals

were captured and kept in restraint in order to be killed at appropriate time for food. The purpose was the same as that behind hunting of wild animals. But the keeping of animals ensures ready availability of food which hunting did not. So at first animal domestication began as nothing but an imporvement on hunting. But gradually man's realisation of the utilities of animal husbandry led to further complicated motivations and techniques. Animal husbandry stopped meaning only the capture of animals and keeping them alive to be killed when necessary. Now man began to breed suitable animals under artificial conditions and animal husbandry, in the true sense began to evolve. It is important to note that there exists the conscious intention of man to breed only certain species among the captured wild individuals. There is a question of selection from among a large variety of wild species, depending on the purpose the beast will serve in human society, once domesticated keeping in mind such factors as strength, speed, size, and meat milk and wool (in case of sheep) production.

However, at the beginning, perhaps our prehistoric ancestors did not make a conscious and careful selection of the species, but soon they began to mind the utility factors and went in these directions. This is evident from the domestication of goat, sheep and cattle for production of milk, meat, hide and other works and that of camel, ox, horse, ass etc. for the purposes of commuting and carrying. Moreover, all these species were perhaps relatively easier to tame and their diet less difficult to obtain near human settlements.

S. Bokonyi defines the essence of animal husbandry as – "the capture and taming by man of animals of a species with particular behavioural characteristics, their removal from their natural living area and breeding community, and their maintenance under controlled breeding conditions for profit",[7] that is, for benefit. According to F.E. Zeuner, the beginning of the processes of animal domestication were

"unintended and not conscious".[8] He is of opinion that the natural contact of man with animal led to the development of domesticating activities. Hunting is one such means of natural contact.[9] The curiosity of man about the wild animal species with which he came into contact played a role here. The domestic animals, at the beginning, retained some of their wild characteristics and underwent little or no morphological change. Later the process developed into a specialised technique, viz., animal husbandry, comprising an occupation for a section of human beings. So what Bokonyi defines as the true domestication of animals begins later only with the Neolithic times. It was about the Mesolithic period that the first signs of animal domestication could be traced. However, it was extremely rudimentary in form. By the Neolithic times, true animal husbandry had begun. Such was, therefore, the background to the cultural stage when man began to depend on animal husbandry along with agriculture for subsistence, thus setting in motion the wheel of a major revolution in the history of human civilisation.

The consequences of domestication of plants were phenomenal. No less were the effects of animal domestication on human and animal society and the whole ecological setting. It must be noted that the process of animal husbandry involved three main factors. First, there was the man who carried out domesticating activities ; then there was the individual of the wild animal species selected to be domesticated ; lastly, there was the domesticated animal as the outcome of the action. The human being captures, influences and transforms the wild animal into a tame version ; multiplies its numbers through breeding in artificial conditions ; takes it to various places far away from its natural habitat ; restricts or kills its wild forms.[10] These are the salient points of the technology. But there are much more complex interactions in the process which influenced the whole human and animal population both directly and indirectly. First and foremost, domestication of animals

affected the diet of the people. It brought greater security in the life of man and this ready availability of food favoured a rise in population growth. The natural surroundings of man would also bear the stamp of husbandry activities and its resultant characteristics. The movements of the people, their clothes, weapons, all would be influenced by the animal species they domesticate. Cross interactions between all aspects of human life is only logical. In a word, the whole life style of human society changed. Moreover, in different geographical regions, different sorts of animal species were sought out by the local men to be tamed depending on their suitability in the circumstances. The occupation of animal husbandry developed differently in different areas. This gave distinct colours to the life styles of different cultures.

No less was the influence on animal world and ecology. The selective taming and breeding of certain species, discouraging the growth of its wild counterpart, obviously led to a shift in the natural ecological balance. Nowadays, the wild Indian cattle is almost extinct, save the gaur. The physical features of the domesticated species underwent morphological changes, as we shall note later in this chapter. Moreover, the pasture land claimed by man for the domesticated animal led to further inroads into the ecological setting. Therefore, what was set in motion involved a phenomenal and all-round change in the world of nature.

Gradually, animal husbandry became a specialized activity. Even when settled agricultural life had taken its roots in the Indian subcontinent, not only did pastoralism exist independent of it, but most often a fully complementary symbiotic relationship was established between them and settled agriculturalist, indicating an abiding influence of pestoralism on agriculture. The importance of an attached or affiliated pastoral element was even true for the urban Harappan culture, as true as was the fact of its dependence on small agricultural villages. For a long time, animal husbandry or pastoralism called for a nomadic life. The

specialization required by it necessitated nomadism in search of food for the livestock. G.L. Posseh points out that, "at some interpretive level it can be asserted that the subsistence economy of Harappan civillization must have depended heavily on animals for power, food, fibre and various other raw-materials. These animals would have required pasture and care either of which would have required specialized handling and a nomadic adaptation"[11]. W.A. Fairservis (Jr.) has explained this factor very well. He reflects that during the urban phase of the Harappan civilization there may have been a critical need for pasture in sind. Outlying and peripheral regions of the civilization such as Eastern Punjab, parts of Rajasthan and Gujarat provided an outlet for pastoral and farming activities. The very factor of distance that was now involved would force the groups of individuals carrying out these activities to engage in full-time specialisation in these outlying areas. Fairservis is of opinion that it was the farming population that was the first major unit to move out to develop new lands.[12] In our opinion, the pastoralists were the vanguards of this moving farming unit.

As we shall see, it was the specialized activities of small village agriculturalists and pastoralists that had supported the huge fabrication of the urban civilization in the Indus Valley. J.G. Shaffer points out that the presence of pastoral nomadic elements in any region provides us with a new set of man-land and man-man relationship in any set-up, especially where there is abandant trace of settled agriculturalists in the same cultural context. We have always been a bit too hasty and preoccupied with only the sedentary agriculturalists. Shaffer is right in pointing out that these relationships posed by nomadic pastoralists have not been adequately exploited in South Asia. Their inclusion in the conceptual models of settlement and livelihood patterns in pre and protohistory 'will significantly alter perceptions of cultural processes involved".[13]

A survey of the archaeological evidences from the earliest

contexts in the Indian subcontinent shows that the animals domesticated by men here included the dog, the sheep, goat, the cattle, buffalo, pig, ass, camel, horse and some birds. Of these birds the only one of any importance, from the point of view of subsistence, is the fowl, of which remains are found from the Harappan period onwards. These animals are currently the most familiar domestic species in the life of the people in this subcontinent. The cow, the goat, sheep, pig, buffalo and fowl constitute the livestock economy of the countries here. The economic value of horse has lessened, however, it exists as a fashionable beast as also the dog in most cases. The sheep dog is still of great importance to husbandrymen. The camel still provides transport in some regions in Western India. Around Baluchistan and further west its importance is abiding. The ass is also still used by some people in India and Pakistan, especially in mountainous regions. Keeping in view these factors, the relevance of the study of origin of these animal species and the development of animal husbandry cannot be doubted.

I
ORIGIN

DOG ***(Canis Familiaris)*** : The dog is possibly one of the first animals to be domesticated by man.[14] J.R. Harlan mentions a C12,000 B.C. dog-remain found in Iraq, which is the earliest of its sort until now.[15] Another early dog-remain comes from the Belt Cave in Iran dated around C 9500 B.C.[16]

Zeuner is of opinion that the dog first came near the human settlements as a scavenger beast, staying in the outskirts of a settlement ; in order to snatch at food the human beings left away A symbiotic association, as Zeuner calls it, thus developed between man and dog by way of scavenging and social parasitism.[17] Gradually, the dog became a companion of the man in hunting. Zeuner is of opinion that dog had become a regular companion of man by about C 6000 B.C.[18]

Domesticated dog has perhaps originated from one of the many races of the wolf and the jackal.[19] However, Zeuner does not rule out the possibility of an original wild ancestor for dog which might have been like an Australian 'dingo'.[20] Antonius regarded the C.F. Poutiatini as the earliest-known domesticated dog and related to the dingo.[21] The Poutiatini gave rise to the sheep-dogs (C.F. matris-optimae)[22] and later to the hounds (canis familiaris intermedius).[23] The frequent occurrence of the matrisoptimae dog in the Bronze Age may be connected with the increasing importance of sheep-breeding in the economy.[24] The dog was perhaps first utilised by the hunters in hunting down swift animals. However, it was in the business of herding of domestic sheep, goat and later cattle, that the domestic dog proved to be of immense help. Thus in the pastoral economy, the dog had a very important role.

GOAT ***(Capra Hircus)*** : Goat is the earliest ruminant to be domesticated after the dog. The ancestry of the Indian domestic goat has not yet been traced to any particular species type. However, as Baini Prasad points out the Capra aegagrus Gmelin, locally known as 'Passang'– a group of the 'bezoar' variety, may be considered as the ancestor of the Indian goat.[25] The bezoar goat occurs throughout the sind, Iran and Asia Minor.[26] Baini Prasad is also of the opinion that the Indus Valley people might have played an important role in domesticating the goat locally.[27] Considering the abundance of goat remains found in most of the pre-Harappan and Harappan sites in Baluchistan, Afghanistan and Sind, the proposition may be taken as true. F.E. Zeuner maintains that the goat may have been first domesticated in Palestine.[28] Iran has been put forward as an alternative home for the goat. According to Zeuner, domesticated goat existed in Iran about C 6000 B.C.[29]

Nearer at home, in Afghanistan at the Aq Kupruk Caves the remains of wild goat/sheep (ovis/capre) has been

recovered from the Middle Palaeolithic levels at Dara-i-Kur.[30] These animal species were analysed by D. Perkins, Jr. who states them to have been potentially domesticable.[31] In the Upper Palaeolithic context at Ghar-i-Mar and Ghar-i-Asp the bones of goat (Capra hircus aegagrus sp.) have been clearly identified.[32] From the Non-Ceramic Neolithic level onwards, the goat is said to have been completely domesticated by man at these sites.[33] The date of this level falls around the seventh and sixth millennium B.C. Hence, even if we accept Zeuner's theory of an Iranian or Palestinian origin of the *Capra aegagrus* we cannot rule out the possibility of Afghanistan as another centre for the domestication of goat.

SHEEP ***(Ovis Vignei)*** : All varieties of domestic sheep, according to zoologists, have descended from four species found wild in the mountainous regions of Asia and Europe : (a) The Urial or Ovis Orientalis vignei, found wild from Tibet to the Elbruz mountains ; (b) Mouflou ; (c) Argali or Ovis ammon : and (d) The Bighorn Group, Ovis Canadensis.[34] Of these various species, Ovis orientalis vignei or the Urial is probably the ancestor of domesticate sheep in India as well as Arabia.[35] However, the Argali also contributed to the domesticated stock in India, although it is of subordinate interest.[36] It is generally believed that the people of Anau is Soviet Turkestan domesticated a variety of Urial and that all subsequent domesticated species of sheep have been derived by selective breeding and crossing of varieties found in Turkestan.[37] However, it is safer to assume a wider region as having been the centre for domesticating sheep. In that respect Iran, Turkestan and Baluchistan – all these regions – may be taken to be the ideal grounds. According to C.S. Coon, Belt Cave in northern Iran is the earliest site (C 6000 B.C. producing evidence of domesticated sheep.[38] However, the Aq Kupruk Caves in Afghanistan yielded remains of wild sheep from the Middle Palaeolithic levels onwards. By the Non-Ceramic Neolithic

stages, the sheep seems to have been domesticated by man here. The data of this period falls around the seventh millennium B.C.[39]

The sheep, as Zeuner points out, was domesticated with the aid of dog, a species domesticated earlier, before agriculture developed fully.[40] The same was the case with even goat. By the time sheep was being domesticated, however, rudimentary agricultural activities may have been taken up by man in more hospitable regions. Domestication of sheep ensured a steady meat supply, also a supply of raw materials like skin, hair, fat and obviously bone. Especially the remarkable supply of fat that the sheep yielded served both culinary and technical purposes.

CATTLE ***(Bos Indicus)*** **:** So far our discussion of the origin of the domesticated species of animals have made us review the situation before the commencement of agriculture in a proper way. Dog, goat and sheep were domesticated in a pastoral environment, where men had not yet settled down to a sedentary life. The first step towards food production as distinct from food gathering was made while goat and sheep were being brought under control of the nomad and his dog. The second step was development of agricultural techniques which tied the man to land. Man now began to settle down permanently in the vicinity of his cultivation fields. Now, we may note that the crops, ripe or otherwise, attracted some large herbivorous wild animals who came to rob man of his precious yield. Man, therefore, caught them and perhaps began taming them in order to kill and eat their flesh at leisure. Later, other methods of utilising them dawned upon him and he began, likewise, to put these animals into various uses associated with agriculture itself as well as transportation and so on. F.E. Zeuner is of opinion that the "the large ruminants which were thus taken over by man include cattle, Indian buffalo (arnee), Yak, banteng and one or two others".[41] There are two main variants of the Bovidae or Bos. The *Bos indicus* is the Indian zebu with its

pronounced hump, while the *Bos primigenious* is the humpless variety.

According to the pilgrim, the Bos *primigenius* and Bos *namadicus* have originated from the ancestral species Bos *acutifrons*, the remains of which have been found from the Siwaliks.[42] The European domesticated cattle are descendants of the Bos *primigenius*[43] while the *namadicus* species provided the cattle (Bos *indicus*) for Asia.[44] Fossils of the Bos *namadicus* is found in the Narmada bed as well as the lower-most gravel-bed in Pravara river at Nevasa, in the Deccan region, both from the Middle Pleistocene levels.[45] In most of the protohistoric sites in India, we find the remains and artistic representations of both the humped and a humpless variety of Bos. The Bos *indicus* is commonly called a zebu. It is typically marked by a prominent hump, upright horns and pronounced dewlap. The other variety is shorter, Short-horned and humpless. Baini Prasad holds that the Indian *Bos namadicus* Falconer from the Pliocene levels in Narmada bed, in its earlier progenitor, *Bos Planiofrons* Rutimeyer is the sole ancestor type of the cattle of the genus *Bos*.[46] From these ancestral types the long horned, humped cattle of Mohenjo-daro and Harappa evolved. As to the short-horned variety, Baini Prasad points out that it is extremely difficult to trace an outside origin.[47] He refers [48] to the conclusion reached by Duerst as to the short-horned variety of cattle found at Anau, that these evolved as a result of morphological change due to a "decline of the cattle breeding".[49]

The Aq Kupruk Caves yielded the bones of wild cattle/ deer (Bos/Cervus) at the Upper Palaeolithic sequence.[50] These evidences indicate the presence of potentially domesticable Bos species of the primigenius variety already in the region of northern Afghanistan. At the Ceramic Neolithic levels at Ghar-i-Mar and Ghar-i-Asp, the cattle bones are indentified by Perkins as possibly domesticated.[51] The Allchins are of opinion that this may have been the

starting point (seventh to sixth millennia B.C.) of the process of domestication of the Bos.[52]

With the domestration of cattle, human civilization, especially in the Indian subcontinent, took a great step forward. For, more than goat and sheep, cattle rendered important and varied services to human beings. Apart from providing a more abundant supply of milk and meat, it worked as a pack animal with great efficiency. It could withstand high temperature and many tropical diseases. Moreover, in an agricultural economy, cattle became more useful to the people. The cattle is essentially an animal of the plains. Hence, as the sedentary farming folks began to settle down more and more in the fertile river plains, they took utilising cattle more and more. Domestication of cattle, therefore, truly depicts the trasformation of man from a nomadic state to a sedentary one.

BUFFALO : *(Bubalus Bubalis)* : Buffaloes belong to the family of Bovidae and tribe Bovini. Baini Prasad agrees[53] with R. Lyddekker that Indian buffalo is the lineal descendant of the *Bubalus Palaeoiondicus* found in the gravels of the Narmada and the top-most beds of the Siwalika.[54] According to him, one of the centres, if not the only one, of the domestication of buffalo in India was the Sind Valley.[55] John Marshall has also suggested that the Indian buffalo had been domesticated by the Indus Valley inhabitants.[56]

The Buffalo is used both for food and physical labour. It is utilised as a draught animal and also for ploughing cultivation fields. The buffalo milk is richer than cow-milk. Buffalo meat is also consumed since the prehistoric times, although this is restricted to fewer people at present.

PIG : *(Sus Cristatus)* : The domesticated pigs are the descendants of a group of wild species of pigs ranging from Europe to eastern Asia. The European representative is the *Sus Scrofa* variety and the eastern Asiatic, *Sus Vittatus*.[57] These two varieties are again connected by transitional

races that are intermediate between the two.

The common Indian form was described as *Sus cristatus* by J. A. Wagner.[58] G. Rolleston gives the description of two skulls of the domestic pig from Monghyr in Bihar and designated them as *Sus cristatus* var. *domescicus.*[59] Baini Prasad himself is of opinion that the remains of this animal found at Harappa difinitely belong to the domestic race of the common Indian pig *Sus cristatus.*[60]

The large number of remains belonging to this animal found at Mohenjadaro also testifies to the fact that people at Mohenjodaro were extremely familiar with this animal and perhaps had domesticated them. However, as J. Marshall points out there is no clear evidence for this fact of domestication.[61] It is possible that they existed in large herds around the countryside, searching for food. However, we cannot altogether rule out the possibility of their having been domesticated. As Zeuner also points out,[62] it is worthwhile to note that the domesticated pig has nowhere been found at sites which are earlier than the Neolithic agricultural stage. We have noted that it is same in case of the cattle. Hence, it would appear that like cattle, domestic pig is also associated with permanent settlement and agriculture. The animal thrives on waste materials and hence it roamed around human settlements, both villages and cities. This explains their presence in large numbers at Mohenjodaro and Harappa.

The chief purpose of pig breeding is undoubtedly the abundant and prolific supply of meat and fat. This animal has a high rate of reproduction and quickly multiplies its numbers. The suckling pig also matures very fast and carries a lot of meat and fat. It can also be fed and kept easily. Hence its utility to farmers and city-dwellers alike. The domestication of pig therefore signifies that by the Harappan cultural phase, man had begun selecting the most useful and convenient animal species that ensured a steady supply of

protein more than the other domestic species in an urban milieu.

Among the wild animal species that were selected by primitive man primarily for the purposes of carrying goods and men, i.e., transport, and for such other labours, the most important are the camel, the ass and, last but not least, the horse.

CAMEL : *(Camelus Dromedarius)* : There are mainly two varieties of camel in the world today. One is the single-humped dromedary which occurs from North Africa to the Caspian Sea and from Arabia to North West India. The other is the two-humped variety, *Camelus bactrianus* L., the bactrian camel occuring from the Caspian Sea through Central Asia to Manchuria.[63] The Indian Camel is a descendant of the single-humped variety. The origin of the dromedary or single humped camel is very much a matter of dispute still now. While a group of scholars like E. E. Cope and J. L. Wortman are of opinion that the ancestral species of the *Camelus Dromedarius* orginated in America in the Late Miocene or the Upper Eocene. Many others like H. Falconer and P.T. Cautley as well as Duerst have reached the conclusion that the *Camelus Dromedarius* originated from the *Camelus Sivalensis*, a fossil of which have been found from the Siwalik Hills. O. Abel regards that the species originated in the Eocene period in Asia and from here spread to America and Europe and in each region developed along specialised lines.[64]

The few remains of camel from Mohejodaro,[65] Harappa[66] and Kalibangan[67] would indicate that in the Harappan days the animal was being utilised by man as a domestic animal. The camels could not compete with the ox, horse or the ass as a beast for transport in most region for it is not as easily bred, fed and watered as the others mentioned. However, its special suitability to the dry, desert regions, makes it an unique help for the folks inhabiting

such climatic and geographical conditions. The camel can go without water for a long period and can travel on sand for long stretches of time. It can eat up the scrub and cactii, the vegetation common in desert. Hence, this animal has helped in a great way in the development of nomadic and semi-nomadic habitations in areas that would otherwise be uninhabitable. In this connections, it should be noted that the caravan of camels helped to connect over-land trade routes throughout the Central, West and South West Asia as well as the Baluch and Afgan borders of the Indian Subcontinent. As a matter of fact this animal has helped in the process of cultural diffusion as well. R.W. Bullet has done researches on the emergence and expansion of camel husbandry and its relation to social, political and economic conditions. He points out that the beast had a profound effect on settled life, building up various social, political and economic contacts.[68] The countries far from each other and interspersed with forbidding desert areas over which only this beast travelled with equanimity were linked up and further cultural development took place.

ASS (*Eguus Asinus Asinus*) : The true ass is of purely African origin. The ass was perhaps first domesticated in Egypt. Here it was known as a domesticated beast from atleast protodynastic times.[69] Baini Prasad also noted a 'close relationship' between the remains of the domestic ass found at Harappa and the African species.[70] He refers to A. Jacobi's theory of the dispersal of this animal and the map that the latter has drawn up, where, it is shown that the African ass moved through a route across Arabia and Persia.[71] From there the animal might have come into the Indus Valley region. Remains of *Eguus asinus* has also been found in Gujarat at Rangpur[72] and Kalibangan.[73] It should be noted that wild ass is still found in the Rann of Kutch and in the desert of Rajasthan as well as in Sind, Baluchisthan, Afganisthan and Iran. However, this species is of the group *Eguus hemionus*. This animal is swift as well as being light.

It can also be easily tamed. Hence, in the days before the horse arrived properly on the Indian horizon. The ass was very useful as a beast of burden. Ass is also of importance as the progenitor of the mule, a cross-breed of mare and a male ass. The Mule has become a very useful animal to the people in the subcontinent, especially in the mountains.

HORSE (*Equus Caballus Linn*) : There are many theories as to the origin of horse. However, the most accepted one is that the animal's original homeland lies in Eurasia. According to F.E. Zeuner, the possible area of its origin is around the West and Central Europe, Western Asia, north of the Himalayas, and Russian Turkestan in the east.[74] He holds that the animal was also first domesticated in the Ukrainian and east Russian steppes, Kazakhstan and steppes of Western Asia including the plains of Turkestan and Turan.[75] Bridget and Raymond Allchin also point that the steppes of Eurasia were the homeland of the wild horse and that the inhabitants of these regions first domesticated the animal for draught purposes. Recent archaeological researches carried out in Soviet Russia also support the view that domesticated of horse may have first taken place in South Russian steppes in the fourth millennium B.C.[76]

In India, the fossil of *Equus Namadicus* has been found in the Pleistocene alluvium of the Narmada Valley and also in the siwaliks.[77] Remains of the horse have been found in some of the early prehistoric sites even in India. However, most of these turned out to belong to other varieties of the genus Equus, such as, hemiones and onagers. E.J. Ross reported four teeth of Equus Caballus from Rana Ghundai.[78] However, F.E. Zeuner identifies them with the hemione variety.[79] The Rana Ghundai material is the earliest found remains of a possible Equus. From period Ic of Surkotada in Gujarat also remains of this animal are recovered.[80]

It was around the third millennium B.C. that horse was being domesticated and, according to Zeuner, the original

centre for its domestication lay north of the Persian mountains, especially in Turkestan. From there the domesticated horse moved over to Europe in small numbers. Simultaneously it also moved into Asia Minor.[81] An extremely interesting evidence of the domestication of horse comes from the Boghazkoy tablet, where treatise on horse training by Kikkuli of Mitanni has been deciphered by Horzny.[82] The date of this text falls around C 1360 B. C. This treatise gives detailed directions for training and is apparently exclusively concerned with chariot-horses. Significantly enough, several of the technical terms used in the text are reminiscent of sanskrit words and expressions.

The invention and development of the wheeled chariot is itself a revolution in the field of mobility and transportation. The conjunction of the wheel and a speedy animal like the trained horse is indeed very drastic. It could change a lifestyle.

By the time the Boghazkoy tablet was being inscribed, the horse had moved into the Indian sub-continent. Pack horses, War Horses, race horses and even ploughing horses are frequently referred to in the vedic literature. It is universally accepted that the Aryans and the horse came hand in hand in this sub-continent, which actually means that it was the in-coming Aryans who brought with them large numbers of trained horses and the wide use of the horse first began with them.

The horse and the wheel now began to have great consequences on life on all levels. Not only did the conjunction of horses and wheeled chariots gave power on war-fields, but political activities as well as trade and commerce also benefited from this. Communications became easier and speedy. Around C 800-600 B. C. the animal was adopted fully in the socio-economic life. The animal which had begun its association with human beings as a companion in war and hunt came to be appreciated for varied other uses allied with transportation.

DOMESTIC FOWL : *(Gallus Gallus Murghi)* :

Turning from the domesticated mammals, we shall how examine the origin, domestication and occurrence of a bird, the fowl, which, from long time back, had played a very important economic role in human society. The fowl has constituted an important part of the protein diet for man since very early days. The centre of origin of the gallus species as well as its domestication is India.[83] The red jungle fowl, according to F. E. Zeuner, is the chief ancestor of the domesticated fowl.[84] The geographical races of the gallus occur from Kashmir to Tonkin and in the Peninsular India, south of the river Godavari.[85] One of the early evidences of domestic fowl comes from Mohejondaro.[86] Sewell and Guha's study of the bones of fowl reveal that they are larger than those of the present bird. A femur piece found at Mohenjodaro measures 103 mm as compared with 69 mm in case of a domestic fowl of Bengal.[87] It may imply that size had been an important factor in case of fowl domestication in the Indus Valley. Full domestication had taken place by the second millennium B.C.[88] The bird was popular among the Central Indian and Deccan Chalcolithic cultures also. The gallus may have been first kept as a sporting bird and later used as a provider of protein in the diet.[89] The importance of domestication of fowl lies mainly for a study of the dietary habits of the past civilization and its links with that of the present.

Now, we must being a careful analysis of the different categories of evidences for animal husbandry that we come across in our scope of study. Here the primary question before us is what exactly are to be considered the evidences for animal domestication in man's pre and proto-history. There are basically three major categories of archaeological evidences that may be used to interpret the state of animal domestication in any prehistoric context.[90] These are supplimented by the references made in this regard in literary sources when the latter are available.

A. The foremost evidence comes from the remains of animals ; i.e. animal bones. from the different excavated sites. The story that these bones tell have many aspects and this category represents perhaps the most concrete of all evidences available.

B. Artistic representations of animals are very important as they may indicate their having been familiar with man and-perhaps domesticated.

C. Lastly, there are the indirect evidences provided by objects or features found at a site which may have been associated with animal husbandry.

A. The remains of animals from the different excavation sites may be analysed from different angles and used in complex ways by Palaeozoologists and archaeologists in order to decipher the exact nature of their relation to the human beings at those sites.

Among the many aspects of the evidence presented by animal bones we begin with the factor of age. Zoologists are able to diagnose the age of animal from its bones. It has been concluded by many scholars that the presence of a high proportion of young animal bones is an evidence for domestication in prehistoric settlements. It was C.S. Coon[91] who first put forward this theory. This was further supported by scholars like E.S. Higgs[92] and S. Bokonyi[93] and has now been accepted as a principle in archaeology.

People practising animal husbandry have a ready reserve of live animals under control. They will therefore invariably select a young animal to be killed for food, as maturity in the animal leads to toughening of the fibres, which is neither nutritious nor palatable. It is only in a hunting community that man is left with not much choice regarding food. Appearance of the remains of very old animals at a site, therefore, is taken to indicate a wild polulation which were hunted by people for food.[94]

At Anau, Duerst reported, that the greater part of the

zoological remains, especially of sheep and pigs, showed a high proportion of bones of very young animlas.[95] The same holds good of the Mohenjodaro collection, where in case of sheep, pig, as well as cattle, bone evidences point to the fact that they were killed young for food.[96] However, this theory is not conclusive and, we have to take recourse to additional factors to come to a difinite conclusion about the state of animal keeping.

The next factor that we are concerned with in this study is the size of the animal species. It has been generally assumed by zoologists and archaeologists that if in an archaeological context where other signs indicate a possibility of animal domestication, size changes can be observed in animal species that are commonly domesticated at present, these changes may be taken up as a good indicator of the animal having been domesticated.[97] It has been pointed out that in the case of pig and cattle, especially, domestication causes considerable decrease in size which can be recognised in the extremity bones.[98] Size diminution is indeed a well-known phenomenon of the domestication of the bovid species.[99]

The principle is now being applied in South Asian archaeology. For example, at Mehrgarh, a pre-Harappan site in Baluchistan, R. H. Meadow has noted an overall decrease in the dimensions of goat, sheep and cattle, especially sheep and cattle throughout the Aceramic and ceramic Neolithic phases.[100] Similar evidences are also noted at the pre-Harappan contexts at Jalilpur[101] and Balakot.[102]

Apart from a decrease in size, domestication leads to other morphological changes in an animal. It is known that in some species captivity and selective breeding may have a marked and relatively swift influence on the size and shape of certain bones. Man domesticates the wild species of animal and brings it to live in human society. They are

subjected to all the strains that the human society puts on and their bodies adjust to such pressures. In the process, deformities occur in the bone structures. A study of these bones recovered from the protohistoric excavation sites may tell us the life-story of these animals, the work they were put to, the way they were kept, the amount of free movement they were allowed, etc., all pointing to the mode of animal husbandry practised by the people that had tamed and kept them.

In a pastoral culture, the domesticated animals are kept in stockades. They are deprived of the free movement they were used to in a wild state. Even while grazing they are herded by man and often dog. Their agility is consequently hampered resulting in restricted interarticular movement which leads to the development of gagged or erect pastern, turned-out toes and turned in hocks. A study of these features of the animal leg, especially the region of hoof, known as 'Pedosis' reveals significant facts concerning animal husbandry. K.R. Alur has noted such features in the animal remains from the chalcolithic site of Kayatha in central India.[103] Moreover, tasks like bearing burdens and the farming yoke to which the large domestic animals have been put from the earliest days had consequences on their anatomy. They leave indelible marks in the animal body. K.R. Alur points out that repeated heavy and concentrated work results in the deformity of bones or bone exostosis, which become manifest on the joints of the animals, especially in the legs. Osseous or bony overgrowth develop on the hock. Once these deformities set in they are permanent.[104] Such exostosed bones are reported from neolithic-chalcolithic site of Hallur in South India and the Chalcolithic site of Navdatoli in Malwa.

Apart from these, the study of the bony horn cores that are recovered from the excavated site, as well as of manus and formation of the medullary cavity also reveal the state of economy in which the animals were kept, the group to

which the particular species belonged, whether a selective breeding was concerned or not etc., giving a total evolutionary picture.[105] However, very few excavation reports are satisfactory in these respects. Hence, we have to rely mostly on other categories of evidences.

B. The artistic representations of animals are most numerous in the prehistoric and protohistoric contexts in the Indian subcontinent. From the very early days of human history in this subcontinent, man had been shaping and drawing the animals around him on cave-walls, pots and pans, making small figures out of clay, giving vent to his artistic inclinations, and inadvertently providing us with clues as to the life he was leading. Depictions of animals on pottery sherds, cave-walls, terracotta and metal figurines of animals, engravings on seals etc. give us a whole gamut of evidence of their existence. But these evidences need to be handled carefully. The artistic representation of an animal does not necessarily mean that it was domesticated by man. Such evidence need to be weighed against other factors and other sorts of evidences in order to draw a conclusion.

We come across Mesolithic cave-paintings and bruisings depicting animals. The Central Indian rock-shelters nearly always yield paintings on cave-walls. Animals were the most common subjects of these paintings. In South India we often find scrapings and bruisings on cave-walls belonging to the neolithic cultural context.[106] Here the main subject seems to have been bulls in a variety of backgrounds.

From the pre-Harappan period onwards we note the occurence of terracotta figurines of domestic animals like bull/cow, ram, etc. in the north-west region of our subcontinent. The Mature Harappan seals also provide interesting depictions of these animals. The favourite animal was the bull.

This practice of making terracotta as well as metal models of domestic animals, especially the bull, as well as

painting animal molifs on potteries, are also evident in the Deccan and Central Indian Chalcolithic Cultures.

However, a careful and objective analysis of the material is required. These materials not only provide answers to the questions like how man treated the animals around him but also deeper ones like how man became conscious of his environment and the other inhabitants of that environment. The pictorial depiction of animals, especially the domestic animals, signifies a social awareness deeper than mere economic considerations. Cows and bulls had become precious, nay, sacred. We have to understand why man began to regard these animals with so much care. However, we always have to weigh this category of evidence with more scientific evidence to make correct analyses regarding the actual conditions of domestication of animals in our context.

C. Last, we turn to the category of archaeological evidence constituting of the objects directly or indirectly associated with the process of animal husbandry. The availability of such objects is quite scarce in the Indian subcontinent, especially in our period. However, we can fall back on artifacts like the terracotta and metal models of wheeled carts and chariots found at the several Harappan sites.[107] Toy models of wheeled carts and chariots have been recovered at Harappa.[108] Mohenjo-daro[109] and Chanhudaro.[110] The copper and bronze models of cars and chariots from Harappa[111] and Chanhudaro[112] display figures of seated drivers. Given the background of the Indus Valley civilization, it will not be wrong to assume that life-size versions of these carts were drawn by domestic animals from the Harappan period onwards.

Terracotta wheels are also found at several of the Deccan and Central Indian Chalcolithic sites, the Painted Grey Ware sites and also at the Northern Black Polish Ware sites. It seems that animal-drawn crats and chariots had

become a familiar part of everyday life. Even when the high stage of urbanity had disappeared from the sub-continent, subsequent to the Harappan times, the vestiges of that life continued to exist in semi-urban villages. A very interesting evidence of this kind have been recovered from the chalcolithic site of Inamgaon in Maharashtra. From here comes a scratched representation of a bullock cart on a pottery sherd.[113] The Vedic literature mentions the chariot quite often along with the horse. In the earliest days the carts were mostly drawn by cattle as well as asses. We can assume from the existence of these toy models of carts, chariots and wheels that life-size versions of these were in vogue in the Harappan times. The Deccan and Central Indian Chalcolithic people were also familiar with these vehicles, especially some sort of cart. Those vehicles were definitely drawn by the large and strong pack animals man had domesticated. References in the Vedic literature corroborates this evidence. By the time of the Northern Black Polish Ware Phase, around the sixth century B.C., domestic pack animals harnessed to wheeled vehicles had become quite a common sight.

The invention of wheels, wheeled-vehicles, and their attachment to the persons of a domestic animal brought about a significant change in man's life style. It added to the speed and carrying capacity of an animal and thereofore had a tremendous impact on the existing economy. Not only did the wheel add a new dimension to human life, it also gave man an excellent opportunity to utilise the animal he had domesticated in a more fruitful manner. Thus man's interest in domesticating potential pack animals increased by leaps and bounds. Here is an excellent example of how technological innovation affected the animal world. Man's interest was drawn towards animals those, which had little to do with his need for food.

The purpose behind animal husbandry, was becoming more and more complex and the more civilization progressed,

THE NEOLITHIC, NEOLITHIC - CHALCOLITHIC SITE IN SOUTH INDIA

MAP-11

KEY

1	KODEKAL	6	SANGANKALLU
2.	MASKI	7	KUPGAL
3.	UTNUR	8	HALTUR
4.	PIKLIHAL	9	PALAVOY
5.	TEKKALKOTA	10	T NARSIPUR

11 HEMMIGE

the more complicated and sophisticated became man's techniques of handling the natural resources at his disposal. The training of domestic species for transport required new skills.

Another very interesting type of evidence, belonging to this category, comes from a Neolithic settlement in the Ganges Valley at Mahagara,[114] as well as several Neolithic ash-mound sites in South India.[115] Excavations and explorations at all these sites indicate the presence of large cattle-pens. A detailed description of these sites and the said pens will be given below while studying the materials from some of the sites separately.

Ash accumulations were first reported by T. J. Newbold at Kupgal in 1843.[116] Subsequently, R. B. Foote also cited several ashmounds in South India and indentified them as Neolithic settlements.[117] F. R. Allchin's explorations and excavations of some of the ashmound sites in the Mahbubnagar District in Andhra Pradesh and Raichur. Ballary and Gulbarga Districts of Karnataka, led him to the conclusion that these represent some sort of Neolithic cattle-pen-pastoral camp sites.[118]

However, more recently, the Allchins have come up with a new suggestion that the trenches alluded to here as stockades for domestic cattle, may have also been used as 'Kaddahs' or traps for capturing wild Bos indicus that roamed in the area and then for keeping and taming these wild animals.[119] Thus the Allchins suggest that these ash-mound sites might have been used in connection with seasonal migrations and forest grazing as well as for trapping and penning wild cattle in the South Indian neolithic context.[120]

All these different categories of archaeological evidences are to a great extent supplemented by the literary sources, viz., the Vedic literature, from C 1500 B.C. onwards. These provide a mine of information regarding the general economy

in the period from the second half of the second millennium B. C. to the sixth century B.C. The Rig Veda, Yajur Veda. Atharva Veda and the associated vedic texts portray a vivid picture of the state of animal husbandry in this period. It is apparent from these evidences that the Early vedic society laid a special emphasis on pastoralism. The Later Vedic society experienced a more advanced state of things with a developed agricultural economy where animal husbandry played a very supportive role.

II
EARLIEST EVIDENCES

We have already mentioned in the introduction that the generally prevalent theory is that the beginnings of animal and plant domestration can be placed in the post-pleistocene phase, in the Neolithic context, which Gordon Childe has termed as the 'Neolithic Revolution'.[121] Recently, however, E.S. Higgs and M.R. Jarman have challenged this traditional theory. They think that it is "unlikely that from say Middle Palaeolithic to post-glacial times economics remained static at a huntergatherer stage. It seems much more likely that economic practices changed and developed throughout this period.[122]

While not rejecting the traditional theory of a 'Neolithic Revolution', we can modify it to accede to the theory of Higgs and Jarman by trying to decipher the stirrings of domesticating activities in the pre-Holocene or Middle Palaeolithic in our region. We would like to mention a few examples, here, where we may trace the beginnings of animal domestication to the Upper, Middle Palaeolithic, Mesolithic and Aceramic Neolithic contexts. In the Indian sub-continent the study will necessarily begin with the Palaeolithic phase in Afghanistan from where we get interesting evidences indicating the very beginnings of animal domestication. Located in north-eastern Afghanistan, at Aq Kupruk, are three cave-sites, namely, Ghar-i-Mar, Ghar-i-

Asp and Dara-i-Kur. The excavations carried out at these sites reveal in the Middle and Upper Palaeolithic contexts the remains of sheep, goat and cattle/deer in an overwhelming quanity. All these species were as yet in a wild state. By the Non ceramic Neolithic Phase at these sites, animal bones reveal that sheep, goat and perhaps cattle had begun to be domesticated. The presence of these potentially domesticable animals in the Palaeolithic contexts in a wild state and their presence as domestic animals in the Neolithic context indicate that the wild species of the Palaeolithic were already locally domesticated by the Neolithic times.[123] That is, sometime in between, those species had been domesticated gradually, perhaps locally.

Going into the details, we find that, at Dara-i-Kur a Middle Palaeolithic level was indentified and dated to approximately C 29,050 B.C.[124] This level yielded the remain of cattle (*Bos Primigenius*) and unindentified sheep/goat. The Upper Palaeolithic levels at Ghar-i-Mar and Ghar-i-Asp yielded remain of sheep (*ovis orientalis*), goat (*capra hircus aegagrus*), horse (*Equus sp.*) and cattle/deer (*Bos/Cervus*) among the domesticable species. A radiocarbon dating places this phase around the 15th millennium B.C. (C 14,665 B.C.). The faunal specimens for these domesticable species constitutes eighty or ninety percent of the total identifiable remains.[125] It becomes quite clear that the wild predecessors of sheep, goat and the *primigenius* cattle existed in the region. Several Soviet Central Asian sites, contemporaneous with these Afghan sites yielded similar evidences.[126] J.G. Shaffer points out that these evidences suffice to indicate that the theory of the diffusion of sheep, goat and *Bos primigenius* in a domesticated state into the Indian subcontinent needs to be re-examined.[127] Coming to the Non-Ceramic Neolithic and Ceramic Neolithic levels we find that the Aq Kupruk sites yield the bones of sheep and goat which were identified as domesticated. The cattle was also most probably domesticated during this time. Interestingly

enough, the horse is listed with the non-domestic animals.[128] Two radio-carbon dates are available for the non-ceramic Neolithic phase, viz., C.8566 B.C. and C 6960 B.C. The dates for the Ceramic Neolithic are C 5018 B.C., C 5214 B.C., C 4549 B.C. and C 2685 B.C. The above date for the Non-Ceramic Neolithic phase marks that the domestication of sheep goat and probably cattle had begun around the ninth-seventh millennium B.C. in this region.[129]

On the basis of these evidences, it would not be wrong to assume that goat, sheep and cattle (*bos primigenius*) that existed in the wild form in the Palaeolithic Phase at the site began to be domesticated locally by the men so that by the Neolithic times these animals were fully domesticated. It should be pointed out here that L. Dupree considers the Neolithic assemblages at the Aq Kupruk caves to represent specialised pastoral nomads.[130] It should also be noted no architectural remains have come up either from the Non-Ceramic or Ceramic Neolithic Phases at the sites, which indicate a nomadic character of the settlements. The fact that although the wild forms of the horse (*Equus Caballas* and *Equus* sp.) were present at Ghar-i-Mar and Ghar-i-Asp at the Neolithic stages, it yet remained in the wild state by the end of the Neolithic, is also interesting and indicates that the animal was indeed not domesticated locally, supporting the common theory of diffusion of domesticated horse into the sub-continent from outer regions.

The next evidence comes from Adamgarh, in Central India. Here, in several rock-shelters in wooded hilly lands we come across Mesolithic habitations. The rock-shelters at Adamgarh hill in Madhya Pradesh near the town of Hoshangabad bear the clearest record of Mesolithic life.[131] The shelters are well-known for their paintings and for the occurrence of Palaeolithis and microliths in the neighbourhood. Debris from one of the trenches at Adamgarh were selected by the excavator, R.V. Joshi, for detailed analyses. These revealed the presence of remains of domestic

dog, cattle, water buffalo, goat, sheep and pig. There were also the remains of a variety of wild animals like the Sambar, Barasingha, spotted deer, hare, porcupine and monitor lizard. The representations of both the wild and domestic species are almost equal in quantity. Some of the bones of cattle, pig and spotted deer are charred which may point to their having been used in the diet.[132]

Two radio-carbon dates are available for Adamgarh. One is based on uncharred bone 1.90 metres below surface which gives a date of 895 ± 105 B.C. The second is obtained from shells at a depth of 0.15 to 0.20 metres below surface and falls around 5500 ± 130 B.C.[133] As we can see there is a great discrepancy in these dates and none can be taken to be absolutely reliable as both uncharred bones and shells are prone to contamination.[134] In spite of this discrepancy, we may take the Adamgarh evidence as an early example of animal domestication in India. In fact D.P. Agrawal is of opinion that in India proper, the Central Indian site of Adamgarh represent a pre-Holocene of animal domestication.[135]

More reliable evidence come from Bagor, a Mesolithic site in Rajasthan. Bagor is a small settlement situated on a dune on the bank of the Kothari river, a tributary of the chambal river in the Bhilwara district. This stream had a seasonal water-flow in the ancient times. There was also an old lake basin near the site. Excavation at this site reveals from the earliest phase —I levels evidence of huts with paved floors and remains of both domestic and wild animals.[136] A preliminary study of the animal bones from the site made by D.R. Shah[137] and K.R. Alur[138] shows that the cattle (Bovini), and sheep/goat (ovis vignel and capra hircus aegagrus) were present in phase —I at this site.The wild species present were the hog deer, wild boar barasingha, jackal, rat and the monitor lizard and fish etc. According to Alur, who examined these bones from phase-I, sheep/goat bones were most common and indicate a domesticated

variety.The cattle bones belong to both domesticated and wild individuals.[139] The phase-I at Bagor therefore seems to have been witnessing a transformation from a hunting -- gathering stage to animal husbandry. The presence of the remains of already domesticated sheep and goat imply that these animals were domesticated much earlier in the region.The evidence of cattle-bones reveal that the task of domesticating this animal had been taken up more recently.

There are three radiocarbon dates for phase-I at Bagor, viz., 4480 ± 200 B.C., and 3835 ± 130 B.C. and 3285 ± 90 B.C. all coming from charred bones in the upper levels of phase-I. Hence, it may be assumed that the beginning of phase-I goes back to C 5000 B.C.[140]

Thus, we come across a few sites which yield evidences for full-fledged animal domestication in pre-Neolithic contexts. This indicates that the beginnings of these techniques were made much ealier in time at these sites atleast. At most of these sites we find that by the Ceramic Neolithic stage husbandry.as an economy had come to stay. These examples may support the theory of Higgs and Jarman that economy did not remain static at a hunting stage throughout the Palaeolithic and Mesolithic. The beginnings of domesticating activities, as we noted above, had already been made before the Neolithic phase.

However, we may also point out here that the effective stage of animal husbandry indeed began from the Neolithic period. This was the time from when onwards animal husbandry and farming took effect as a common economic occupation. Only when such activities reached a quantitative peak did an all-round qualitative change from the hunting-gathering to the husbandry stage take effect. The causes and conditions for the 'Neolithic Revolution' had been prepared and the stage set in the pre-Neolithic times. It was only after the Neolithic period that man's husbanding activities rendered him somewhat independent of the wild nature. Thus we can

bring togather the theories of both a 'Neolithic Revolution' and pre-Holocene beginning of economic development from the hunting-gathering stage in our context. Interestingly enough, we have seen above that a variety of geographical regions were involved in this process, viz., north east Afghanistan with a cold climate, little rainfall and scanty vegetation, the Central Indian wooded hills and streams ; and the Rajasthan lake and dune area. The picture that arise is that of an almost simultaneous spurt of human activities towards a more sophisticated livelihood, a graduation from a lower economic stage to a more developed one. However, this was not an uniform development.

THE NEOLITHIC CULTURES IN

THE NORTH-EAST : In the south Baluchistan on the broders of the Indus Valley, the Neolithic stage came very early at the site of Mehrgarh, with this site the technology of animal husbandry in the Neolithic context truly unfolds around the sixth-seventh millennia B.C. The site of Mehrgarh lies in the Kachi Plains on the Western bank of the Bolan river, near the point where the river emerges from the hills via the Bolan Pass. The region enjoyed a perennial water supply and fertile alluvial soil with light vegetational cover.[141] Here, the early levels of the period I (levels 17 through 4) yielded the remains of wild cattle *(Bos? namadicus)*, wild sheep *(Ovis? orientalis)*, wild goat *(capra? aegagrus)*, wild water buffalo *(Bubalus bubalis)*, half-ass *(Equus hemionus)* and wild pig *(sus scrofa)* among those of the other wild species. It becomes clear that these animals existed locally in the wild state and were hunted down by the inhabitants of this period. This level is designated as the early Aceramic Neolithic phase and dated before the sixth millennium B.C.[142] We have also come to know that barely and wheat were cultivated at the site from the earliest levels of period I.[143] It may have been so that some of these beasts came near the site as crop-robbers and were killed by the local people to protect the crops. We have already mentioned

F. E. Zeuner's theory that the cattle first came into human contact as a 'crop-robber' and then was domesticated by man.

Gradually, the trend began to change and from the late period I Phases and overwhelming dominance of the remains of domestic sheep, goat and cattle is noted among the total faunal deposit, comprising almost fifty percent of the remains. According to R.H. Meadow, who analysed the material, the evidence is good enough to prove that these animals were kept by the people of the late period I, which definitely came to an end by the middle of the sixth millennium B.C. at the latest.[144] Meadow points out that an analysis of the excavation works and debris recovered reveal a shift from the hunting of wild animals to the keeping of domestic sheep, goat and cattle during the Aceramic Neolithic phase.[145]

The osteological evidences indicate this shift. First, the osteometric data from Mehrgarh reveal an overall decrease in the dimensions of cattle bones over the Aceramic Neolithic sequence to the Ceramic Neolithic. By the period II the decrease in size of cattle had reached its saturation point.[146] The same is true of sheep and goat at Mehrgarh.[147] We have already noted that such pattern of size diminution, especially in case of cattle, sheep and goat, is indicative of domestion of these animals.

The osteoligical evidences from this site also clear some of the doubts regarding the local domestication of the Indian humped (Zebu) cattle. (We have already gone into the discussion of the probability of domestication of the *Bos primigenius* variety at Afghanistan). R. H. Meadow points out the recovery of a single dorsal spine of a thoracic vertebra with a shallow notch, a charecteristic of the Zebu cattle, from the Aceramic Neolithic level here[148] Secondly, all the specimens of skulls recovered from Mehrgarh Late Period I and Period II reveal flat orbital rims, a characteristic found in the case of the zebu and also in the Young of the

taurine *(primigenius)* cattle, but in case of the taurine the flat rim is without exception replaced by a sharp rim in the older age group. The Mehrgarh examples of skulls principally belong to adult animals and hence belong to the *indicus* variety.[149] Lastly, a single skull with the occipital profile intact was found with the distinctive upward and backward pointing cornual ridges a characteristic of the zebu.[150] Meadow also points out that the above mentioned characteristics of the skulls noted at Mehrgarh are also common to the fossil specimens of *Bos namadicus* from South Asia. Hence, he goes further to suggest that the zebu *(Bos indicus)* of the present days was locally domesticated at Mehrgarh from a wild form.[151]

Another interesting point to note is the increasing preference for the humped cattle against sheep and goat at this site during the course of the Aceramic and Ceramic Neolithic periods.[152] During periods II A and II B (C 5378 ± 120 B.C. second half of the sixth millennium B.C.) sixty-five percent of the total faunal remains belong to the cattle.[153] This was also the period when the people at Mehrgarh were carrying on full-fledged agriculture. Cattle, a beast very much associated with agriculture, naturally became popular. The Kachi Plains provide an ideal setting for development of agriculture and cattle herding. We may note that the Aceramic Neolithic lower and intermediate levels (perod I) at Mehrgarh have yielded the following C 14 dates (all uncalibrated), viz., 5182 ± 80 B. C., 5378 ± 290 B.C., 6743 ± 250 B. C., 7716 ± 120 B.C. and even 11,790 ± 120 B.C.[154] Thus, by the beginning of the sixth millennium B.C. the Kachi Plain of South Baluchistan witnessed the evolution of a mixed stock animal husbandry.

Around the end of the fifth millennium B.C. at Kili Ghul Muhammed, a small site in Baluchistan near Quetta, the stage was being set for a demonstration of cultural progress. Four cultural stages have been revealed by excavation at this site.[155] The upper-most levels of the earliest period I

produced radio-carbon samples yielding dates around 4499 B.C.[156] In this earliest phase there was a complete absence of pottery[157] but enough evidence to indicate that the inhabitants were exploiting domestic sheep, goat and cattle.[158] The initial structures here were constructed of pisé, wattle and daub.[159] The Allchins are of opinion that the initial settlers at the site may have been nomadic pastoralists[160] who settled at the site with their herds for a more permanent life. From the subsequent periods crude, hand-made pottery and mud-brick-pisé structures begin to come.[161] Shaffer correctly points out that Kili Ghul Muhammad I-II represent a settlement of sedentary agriculturalists dependent upon animal husbandry.[162] Shaffer also suggests that lying just across the Afghan broder from the Kandahar region, this site may have been 'analogous to developments in Afghanistan'[163] noted already.

North-east of Kili Ghul Muhammad, in the Loralai Valley in norther Baluchistan, a settlement was springing to life at Rana Ghundai. The excavations revealed no trace of structures in the earliest levels, period I. The excavator, Brigadier Ross suggested a nomadic occupation throughout this period. Remains of *Bos indicus, Ovis vignei, Equus asinus* and *Equus caballus* were reported by Ross.[164] However, as we have already noted above, F.E. Zeuner doubts the points the indentifications of both horse and ass by Ross.[165] Zeuner points out that the ass, an animal of African origin, could not have been likely to be present in north Baluchistan at this early date, which, as Zeuner mentions is placed by Piggott[166] earlier than the third millennium B.C. Zeuner suggests that the remains of the ass identified at Rana Ghundai by Ross might have actually belonged to the hemione species, which still survives in the north-western India. About the remains of horse, Zeuner points out that the four equine teeth are not enough for a definite identification and suggests that they might have also belonged to the hemione species.[167]

Apart from this problem regarding the domestication of horse and perhaps ass, the faunal remains at Rana Ghundai substantially prove that the earliest occupants were herding and explointing domestic cattle and sheep around the end of the fourth and beginning of the third millennium B.C. This occupational level at Rana Ghundai may correspond with the Kili Ghul Muhammad period II.[168] Interestingly enough, from the Rana Ghundai period II sequence terracotta humped bull figurines occur,[169] suggesting a close link between this domestic animal and human livelihood at the site. This period also yielded mud houses, a black-on-buff ware and a painted red-on-red pottery[170] indicating the growth of a full-fledged sedentary life at the settlement by the period II.

Coming down to Central Baluchistan in the Kalat state, two habitations can be noted in the Surab region of the Sarawan highlands, namely, Anjira and Siah Damb. Excavations at these sites revealed that the earliest period I levels are comparable to the semi-nomadic occupation at Kili Ghul Muhammad period II.[171] At Anjira, the period I levels produced cattle and sheep remains, flint implements hand-made potteries[172] but no occupational structures. The evidences suggest the presence of a nomadic pastoralist group who were herding sheep and cattle in the region. This period is placed around C 4500 B.C., while the period II begins around C 4000 B.C.[173]

Coming to the Indus plains one encounters the site at Gumla, where the earliest settlers used stone-tools and community ovens and exploited domestic animals.[174] The location of this site is similar in some ways to that of Mehrgarh. Gumla lies on the right bank of the indus, on the alluvial plains of the tributary Gomal river. No structures were revealed in the levels of period I at the site. Ceramics are also absent from this period. Ground stone tools included saddle querns, rubbing stones and pestles,[175] which may indicate some kind of food production having been practised. However, there is no report of floral remains. The faunal

remains appear to have belonged to domesticated sheep/ goat and cattle.[176] A.H. Dani suggests that this period may represent the occupation of a mobile population at Gumla.[177] The absence of structural remains and the non-ceramic context support this theory. The cultural assemblages suggest that the non-ceramic period I may be linked with Mehrgarh I and Kili Ghul Muhammad I.[178]

Thus, we find that around the middle of the fourth millennium B.C. in some regions in Baluchistan, north Afghanistan and the Indus Valley man was making efforts at furthering the cultural progress which began with the first attempts at mastering some of the natural resources him. By this time he was evidently handling the domesticable animals in the region and had attained a degree of efficiency in doing so. The very early beginnings made at the Aq Kupruk sites is quite remarkable. The people at Mehrgarh were not very late at catching up the job on their turn. One thing is of interest here : while, at the Aq Kupruk sites the cattle is reported as the *Bos primigenius,* at Mehrgarh, as we have noted above, the humped *Bos indicus* variety was evidently quite popular. The existence of both these species in the wild form and the very early domestication of these varieties at the two sites respectively is very significant and may add to or alter the prevalent theories regarding the origin and centre of domestication of both these species of cattle. Moreover, the prevalent theory also states that sheep and goat may have come into the Afghan-Baluchistan and Indus regions from the West Asian regions. Here, the existence of both the species in wild form in the early contexts at the Aq Kupruk sites of Ghar-i-Mar and Ghar-i-Asp as well as at Mehrgarh and their subsequent domestication at these sites is again to be considered.

Apart from these suggestions for the origin and domestication of cattle, sheep and goat, the above evidence makes it amply clear that around the fourth millennium B.C, the first stages of the 'Neolithic Revolution', as far as animal

domestication goes, was ushered in the north-western part of the Indian sub-continent.

NORTHERN NEOLITHIC : The norther-most part of India witnessed the dawn of the neolithic civilization around the middle of the third millennium B.C. The ancient site at Burzahom in the Srinagar district in Kashmir yielded evidences of a neolithic settlement in the earliest levels, period I, characterised by dwelling-pits where the inhabitants lived.[179] The phase II levels at this site yield very interesting evidences as to the relationship of human settlers and the animals they kept or probably hunted. This phase is characterised by structures of mud and mud bricks, a black burnished ware, polished stone axes and bone tools.[180] Here we come across some burials of animals which give rise to a lot of speculation. Animals like the dog, ibex and wolf were found buried in regular graves.[181] This practice of burying animals became a regular custom in phase III sequence at Eurzahom. However, this belonged to later times.[182] But what is apparent here is that the practice was being adopted for the first times in the Neolithic context. This novel custom may imply that the neolithic settlers sacrificed pet animals like the dog and ibex during the disposal of human body and the bones of these animals were deposited along with the burial of the human skeleton. It may also signify that to the neolithic settlers, these animals had some totemic significance in their relationship with their masters.[183] It is also apparent here that feelings of personal possession in connection with pet animals had begun to develop.

It needs to be pointed out here that A. K. Sharma suggests, on the grounds that both the wild and domestic varieties of the dog was present at Burzahom and no other neolithic site, eastern or southern, that the domestication of dog took place here in the Burzahom Neolithic some time during the C 2000 B.C.[184] Karthikeya Sharma has also conceded and mentioned this point.[185] Purushottam Singh

mentions that the remains of dog, sheep-goat or ibex, humped cattle and even buffalo, all of domestic variety, were recovered from period II levels at Burzahom.[186]

Recent explorations in the Kashmir Valley have brought to light a host of neolithic sites similar in characteristics to those of Burzahom, like, Gufkral, Begagund, Hariparigom, Olchibag, Pampur, Panzgom, Sombur, Waztal and Brah, all in district Anantnag.[187] Recent excavations at Gufkral yielded evidences indicating the domestication of a selected variety of animals like sheep and goat in the earliest levels of occupation. Hunting of wild games like wild sheep, goat, cattle, red deer, wolf and Himalayan ibex, was also practised.[188] The process of domestication was accelerated in period IB although largely supplemented by hunting.[189] The process was said to have been complete in period IC.[190]

It appears, therefore, that around the beginnings of the second millennium B.C. domestication of dog, sheep and goat was taking place in Kashmir and that the cattle was taken up a little later to be domesticated. As to the suggestion of A.K. Sharma that dog was locally domesticated in Kashmir, independent of outside influences, we have to await the results of further excavations at other neolithic sites in Kashmir before we can come to any certain conclusion. However, the importance of dog in a context where sheep and goat herding was common should be considered.

THE GANGES VALLEY - VINDHYAN PLATEAU

The Ganges Valley and the Vindhyas have witnessed the growth of human population and cultures from the Epi-Palaeolithic and Mesolithic times to the Neolithic as is evident from a number of settlements discovered in this region. The twin sites of Mahagara and Koldihwa in the Belan Valley provide quite interesting evidences for animal domestication and cereal cultivation.

At Koldihwa and neighbouring Mahagara Neolithic occupational debris have been recovered beneath the

Chalcolithic deposits. There are several strata of circular huts, marked by post-holes.[191] Coming to our special area of interest we find that the Neolithic levels at both these sites have yielded a large number of animal bones belonging to the following species : Cattle (Bos-indicus bovidae), sheep/goat (Ovisvignei-capridae), deer (cervidae), horse (Equidae), wild boar (Sus scrofa), tortoise (chelonia) and fish.[192] The presence of cattle, sheep and goat is also attested by a number of hoof-imprints which were recovered in good condition on the ancient surface excavated.[193]

Moreover, at Mahagara a particularly interesting piece of evidence awaits us — a cattle-pen, marked by post-holes around the perimeter and by cattle-hoof impressions within, like the ashmound at Utnur which we shall discuss later. Here, the cattle-pen is quite large and rectangular in plan, measuring about 12.5 + 7.5 metres. It is situated at the eastern fringe of the south-eastern sector of the settlement and surrounded by huts on all sides. The pen is enclosed by twenty eight post-holes, ranging in diameter from 10 cm to 15 cm. It had three openings controlled by two posts on both sides. One opening was made at the western side of the pen and two at the eastern side. A large number of hoof-impressions of cattle of different age-groups were noticed in clusters within the area enclosed by the post-holes.[194]

The existence of the cattle-pen is very interesting and may indicate that the bovine species here were fully domesticated and kept inside stockades in herds. Moreover, there is also the osteological evidence that some of the cattle bones recovered at koldihwa and Mahagara belonged to a wild variety.[195] These evidences may suggest that the region witnessed a transition of the wild cattle into the domestic state locally which might have taken place at and around Neolithic Koldihwa and Mahagara.

Here we would like to mention an interesting suggestion made by G.R. Sharma, quoted by Shashi Asthana, Viz., that the cattle pen at Mahagara shows that the cattle was not family

property but the community property.[196] To this Asthana disagrees and adds that "all folk examples in India show that cattle is always a family property even though they may by kept in a common cattle-pen.[197] Now, we would like to point out here that the existing data do not give us any guidelines to the development of the concept of property and the social practices in this regard at Neolithic stage at Mahagara or elsewhere, for that matter. In such conditions any suggestion on this matter is purely hypothetical and cannot be corroborated with actual evidences. Therefore we do not propose to deal with the study of social status of cattle as a property in this context.

Another interesting fact at these sites was the presence of the bones of the horse. The report points out that there were no traces of the wild variety of this species in the region.[198] It is also quite certain that this is the earliest report of remains of horse in the Ganges Valley region. The bones here belong to a domesticated species, however, they indicate that the animal was of a pony size.[199] At the present state of our knowledge this presence of a small-sized horse at a neolithic stage in the Vindhyas-Ganges Valley region cannot be explained satisfactorily.

Coming to the age of the sites we note discrepancies. For, while the radio-carbon samples from koldihwa give us the dates like - 6571 ± 210 B.C., 5440 ± 240 B.C., 4530 ± 185 B.C.,[200] the dates from Mahagara are much later and moreover, quite inconsistent. Of the six dates obtained from samples at Mahagara, three range from 2265 B.C. to 1400 B.C., the other three falling around 1400 B.C.[201] The Alichins suggest that the Neolithic culture of Koldihwa and Mahagara may more plausibly be dated to C 1500 to C 1600 B.C., and also point out that the succeeding chalcolithic phase at these two sites supports this dating.[202] However, we cannot, as yet, come to any difinite conclusion regarding the dating, considering the samples from Koldihwa which definitely provide a much earlier time-bracket for the Nelithic phase there.

EASTERN INDIA

At the very beginning here, we would like to mention that the evidences for animal husbandry are very scarce at the neolithic sites of Eastern India. Firstly, very few neolithic sites have been excavated in this region. Secondly, those that have been excavated are in most cases not reported to have yielded any significant evidence for domestication of animals. In the circumstances we are left with general pictures of the life-style of the neolithic floks in the region from which broad conclusions may be reached regarding their economy, but no conclusion can be drawn with certainty.

However, the neolithic site of Chirand in Bihar proves to be an exception. From the ancient site at Chirand, District Saran, Bihar, a full-fledged Neolithic cultural habitation was excavated.[203] A large number of animal bones were recovered from the site, among which those of the buffalo, and ox are reported, besides wild species like elephant, rhinoceros, stag and deer. Fish bones and scales were also recovered in large numbers.[204] Besides these evidences, terracotta figurines of humped bulls and some terracotta wheels were recovered.[205] Although the presence of the wheels may not, in the neolithic context, be an indication of a developed mode of transport represented by oxdrawn carts, yet, the suggestion cannot be totally dismissed.

Very interesting evidence were recovered from the neolithic context at Chirand in connection with cultivation of crops. A few examples of charred rice along with other charred cereals were also recovered from the site.[206] The habitational structures of the early phase are represented by floors prepared below the ground level. Later the floors were made on ground level and evidences for reed-walls with mud plasters are encountered. Circular paved floors were also recovered with post-holes located at regular intervals. One semi-circular hut was provided with several oblong ovens, probably representing community kitchen, as suggested by B.S. Verma. a variety of

hand-made ceramics, the bulk being a red Ware, were also recovered.[207]

The above evidence provides a clear picture of the conditions of life in neolithic Chirand, where cultivation of crops and animal husbandry had already been adopted as means of livelihood which was still supplemented by hunting as is evident from the frequent appearance of lithic tools and wild animal bones — as Verma points out. Fishing was also popular.[208] One of the carbon 14 samples collected from the earliest levels of this site has been dated to 3600 ± 100 B.P. (TF. 445) which falls around C 1500 B.C.[209]

Unfortunately from on other excavated neolithic site in eastern India do we get clear reports of animal remains. However, as we have already stated, even in the absence of the reports of actual remains of animals, we may deduce the kind of economy in vogue at many of these sites from the indirect evidences of general life-style indicated by excavations carried out at the sites. For example the excavations carried out at Deojali Hading in North Cachar Hills of Assam by Prof. M.C. Goswami and T.C. Sharma revealed that the neolithic men here lived in mud-walled houses. They possessed cord-impressed thick grey ware as well as thin-walled, well-fired red wares. Among the stone tools recovered are querns, milling troughs and mullers which may point to some sort of cultivation having been practised.[210] It was reported in the Indian Archaeology — 1963-64 — a Review that a sequence of the Neolithic Culture of the Jhum cultivators was revealed here.[211] B.K. Thapar also suggests that the Neolithic people at Deojali Hading and Kuchai in Orissa were acquaninted with husbandry as implied by the presence of pounders and grinding stones etc.[212] The total picture of life-style also suggest a farming economy. But it is not clear whether the people here were practising animal husbandry or not. As matters now stand, we cannot say that the neolithic settlers in eastern India had a developed economy based on full-fledged husbandry of plants and animals with any certainty, as far as West Bengal,

Assam and further eastern states are concerned. The evidences imply a shifting population, leaving little debris at any place. Nomadic herding cannot be ruled out.

SOUTH INDIAN : Neolithic South India provides extremely interesting evidences for the pattern of animal husbandry practised in that context. Most of the neolithic sites occur in the states of Karnataka and Andhra Pradesh and a few in Tamil Nadu. Generally, we come across two types of Neolithic settlements in these regions, viz., permanent settlements with full-fledged cultural debris and structural remains, indicating neolithic villages ; the second, a group of sites, marked by ashmounds, which appear to have been temporary or seasonal camps as indicated by the limited cultural debris and absence of structural remains resembling huts etc. These last might have served as temporary camps for the nomadic herding folks of the neolithic context. It would not be wrong to assume that the temporary camps as represented by some sites were offshoots of the permanent habitations.

Most of the neolithic settlements were found located on levelled terraces at the foot of hills or on sides or tops of hills which were lightly wooded and gently sloping. A perennial or atleast a seasonal water source would not be very far off from these sites. There is a great concentration of sites around the upper courses of the Bhima, Krishna and Tungabhadra rivers. Almost all the sites lie in a zone of less than 25 in. annual rainfall.[213] The concentration of settlements in the lightly wooded or scrub and thorn areas is natural in the neolithic conditions, for here the people did not have to clear heavy forests in order to settle down and carry on their livelihood centering around subsistence farming. We may note that the neolithic settlements in the north-west (Baluchistan, Afganistan and Sind) were also located in the regions with light vegetational cover.

We begin our discussion with the permanent habitations. Such occupations have been discovered at Piklihal,[214] Maski[215]

Tekkalkota.[216] Sanganakallu,[217] Hallur,[218] T. Narsipur,[219] Brahmagiri,[220] Terdal,[221] Hemmige[222] in Karnataka, Palavoy[223] in Andhra Pradesh and Paiyampalli[224] in Tamil Nadu. At most of these sites there are evidences for animal husbandry, along with small-scale cultivation and hunting as the means of livelihood. K. Paddayya summed up the evidences from these sites and mention that atleast twenty-four species of animals are represented in the faunal assemblages from these sites. Of these, nine species were of the domestic variety, viz., cattle (Bos indicus L.) buffalo (Bubalus bubalis L.) sheep (ovis vignei Blyth), goat (Capra hircus aegagrus Gmelin), dog (Canis familiaris L.), fowl (Galus sp.) and ass (Equus asinus L.)[225] At Hallur from the upper phase of the neolithic-chalcolithic-megalithic overlap a few bones of the horse were recovered. Presumably, these belonged to the meglithic culture. For apart from this stray find of horse at Hallur there is little to suggest that this animal was associated with the neolithic culture in South India on any solid basis.

Excavations at Piklihal revealed an extensive neolithic settlement. Situated in the Raichur District of Karnataka, the site is surrounded by little granite hillocks. The terraces and saddles were covered with neolithic debris.[227] The excavation revealed the earliest settlement on a small shelf of naturally level rock in front of a rock shelter. An artificial extension of this rock platform was made by the settlers with boulders and stones. In the crevices of this platform were found early neolithic pottery and two fragments of terracotta figurines of humped cattle. Allchin places the period I at Piklahal between C 2300 and 1800 B.C. Several trenches yielded animal remains at Piklihal, analysis of which indicated that there were three main domestic species in the neolithic period, viz., the sheep, goat and cattle. Among these, the remains of cattle far out-number those of the other species. A study of cattle bones revealed that the neolithic cattle was indistinguishable from the bones of modern cattle of the region. The bones of all the species were mostly in fragmentary form and show signs of

often having been split to extract the marrow or broken, so that there can be no doubt that these animals were eaten by the neolithic folks at Piklihal.[228] The neolithic terracotta figurines of cattle from Piklihal depict a lightly built breed with prominent hump and long-curved horns.[229] We shall see below that rock bruisings near Pilihal and at other places, also dated to the Neolithic period depict this variety of the Indian humped bull.[230] The fact that cattle formed the major portion of the domestic animal population at the site point to the possiblities that by this time, agricultural activities had taken roots among these neolithic people. As we shall see actual evidence for some sort of agriculturre also comes from a few of these permanent neolithic settlements in South India.

Maski, again in the Raichur District, Karnataka, also yield a lot of evidence regarding neolithic animal husbandry in this region.[231] The site is surrounded by gneissic outcrops, rising some 400 ft. above the plains. The Maski nullah, a tributary of the Tungabhadra, flows to the north of the site, access to which was obtained through a gorge on the north side.[232]

Here the excavation yielded three main cultural periods. Thapar designated the period I occupation as the Chalcolithic culture.[233] However, as we find, copper is represented in Maski period I by a lone rod of indeterminated use and that too from mid-level of this period.[234] As Thapar also points out, it is evident that the earliest occupation at Maski, which begins around the first half of the first millennium B.C.,[235] was basically and essentially a neolithic cultural phase, where a slow infiltration of copper was taking place.[236] Indeed, here we have taken up Maski especially because the evidence from period I at this site represents the cultural situation of a very interesting phase - an overlap of neolithic and chalcolithic. In fact, we think that it will be extremely interesting and important to note the conditions for animal husbandry in this period of transformation to decipher if any fundamental change occurred in husbandry techniques between the neolithic and the chalcolithic cultural contexts.

Coming to the faunal remains from this period, we find that the largest number of bones belonged to the zebu,[237] the Indian Humped cattle. Bhola Nath, who studied the material concludes that the cattle remains from Maski closely resemble the smaller, humpless, short horned variety that we have come across at Harappa.[238] At the latter site, Baini Prasad had distinguished the presence of the two varieties of cattle, the one as mentioned above and the second, a large, long-horned, humped cattle.[239] Already, the artistic representations from Piklihal indicate the presence of this last group of cattle in the South Indian neolithic culture. Below we shall come across further evidences for the presence of this large variety as well as the smaller variety too.

The next domestic species present in large numbers in period I levels at Maski is the domestic sheep.[240] A few remains of the goat also come from this period, the bones of which closely resemble those from Harappa.[241] A lone specimen belonging to the buffalo comes from this period.[242] But it is not enough to prove whether the animal was kept in large herds as a domestic animal. Bhola Nath mentions that a large number of remains from this period belongs to young animals.[243] a feature of rudimentary domestication. The first thing to note from the above evidence is the presence of an overwhelming number of cattle at Maski period I, sixty-five fragments coming from layers belonging to this period as against a total number of eighty-five fragments recovered from the total excavated strata at the site.[244] It clearly implies that the earliest occupants of the site were practising a pastoral economy, specialising on cattle herding. The substantial number of sheep remains also come from period I, totalling to thirty-six. Fragments[245] of goat recovered from the site belong to this period.[246] It appears that the period I occupation at Maski represented a settlement of primarily neolithic pastoral folks, engaged in a mixed-stock farming of cattle, sheep and goat, specialising in cattle herding. The stage was set for further economic growth, as Thapar mentions that a tendency towards food-growing is evident.

However, compared to the evidences from Piklihal, Maski does not show any novelty. Both the sites, we may note, were situated in similar ecogeographical background, in the Raichur district. The domestic species herded by the people at both sites are similar. At both sites we note an emphasis on the cattle. The only implication may be that these species were meeting the requirements of the people quite satisfactorily from the early neolithic phase to the late neolithic-chalcolithic overlap phase.

Now we would like to discuss the evidences from Paiyampalli, a neolithic settlement in the North Arcot district of Tamil Nadu.[247] We may mention here that this site represents the southern-most non-metal using neolithic occupation,[248] and as such, is of some interest to us. Indeed, we take up Paiyampalli separately for this provides the only thorough evidence from the southern-most region of India. Here two periods of occupation were revealed by excavations under S.R. Rao. The period I belonged to the Neolithic phase. It is further sub-divided into two phases, viz., period IA and IB. A radio-carbon dating places the Paiyampalli period I at 1390 ± 200 B.C.[249]

At period IA levels excavations revealed dwelling-pits, cut into the natural soil, roughly oval or circular and oblong, marked by rows of stones as well as post-holes in some cases. These indicated the habitational structures of the neolithic folks of period IA.[250] However, in phase B a marked preference for built-up huts with wooden posts over the dwelling-pits could be noted.[251] This indicated a definite improvement in the standards of technology and economy.

The faunal assemblages in the total Neolithic context at Paiyampalli comprised the remains of the bovid group, sheep, fowl, spotted deer, pig, jungle cat and rhinoceros.[252] Obviously cattle, sheep, fowl and perhaps pig represented the domestic animals kept by the neolithic settlers at the site. The picture here is that of a typical village life where the keeping of fowl and

pig around the household is very common. The presence of herd animals like cattle and sheep indicate that pastoralism was also practiced to some extent. Paiyampalli, therefore, provides a very complete picture of a neolithic settled village life, with evidences for poultry, pastoralism, hunting and as we shall see in another chapter, small scale agriculture.

After this survey of the settlement sites, now we pass on to the ash-mound sites. As early as 1916, Bruce Foote had deduced that the ash-mounds that are seen in South India quite frequently, represented neolithic sites.[253] He also pointed out that these mounds were probably accumulations of cow-dung with some forming what he called 'cinder-camps'.[254] Later excavations revealed neolithic debris below these ash-mounds. Such ash-mounds lie scattered in the Bellary, Raichur, Gulbarga and Mahbubnagar Districts of Karnataka and Andhra Pradesh. The excavations carried out by F.R. Allchin at Utnur[255] and Kudatini[256] as well as his explorations at other sites led him to the conclusion that these ash-mounds covered the existence of successive layers marked by cattle-pens,[256] and more recently the theory that the trenches revealed under these ash-mounds might have been some sort of Keddah or trap as well as cattle-pen was also put forward by the Allchins.[257] The evidences from most of these sites do indicate some favourable pointers to this theory.

The village of Utnur lies in the eastern part of the Raichur Doab, in the Mahbubnagar District of Andhra Pradesh, about seven miles north of the river Tungabhadra. The ash-mound lies in the centre of a small outlier of Dharwar rocks. The topography of the area is relatively open, the nearest hills being granite out-crops and small quarts reefs. A tributory of the Ij stream flows to the north of the site. This stream flows only after rains, however, its bed provides a more or less perennial source of water.[258]

The earliest occupational signs were provided by a cut or trench of roughly square plan, some 200 ft. on each side,

between 13 ft. and 15 ft. in width and not more than 1 ft. deep. On the inner side of this trench, the earth was banked up and Allchin assumes that this bank was probably reinforced by a thorn hedge. Inside, the floor of the trench, even at this lowest level, was found to have been heavily trampled and impressions of several animal hooves were found intact, which testify the presence of animals within the inner circle of the artificial trench. The outer circle, which was surrounded by a second lot of post-holes, contained potterysherds, charcoal and cattle bones in fragments — all of which can be generally associated with a human occupation. Allchin designated this layer as the period IA at Utnur.[259]

The hard, almost vitreous surface of the layer 12 associated with next period IB indicated a burning having taken place.[260] However, the surface is clear of traces of ash. Allchin points out that a burning was followed by a clearing of the ash from the whole excavated surface.[261] The findings of a light loamy soil immediately on top of the burnt surface of layer — 12 may represent according to Allchin a levelling of the site preparatory to new constructions, for this loamy soil occurs only with the lines of the post-hole which is associated with this period. Allchin puts forward that evidence from this period IB may represent a levelling associated with a low bank and thorn hedge around the perimeter of the pen, on top of which cow dung accumulated to be finally burnt.[262] Here we may mention that a scientific study of the ash was made by F.E. Zeuner who came to the conclusion that it represented burnt cow-dung.[263] It also ought to be mentioned here that a charcoal sample from this period was analysed and it gave the C 14 date of 2160 ± 150 B.C.[264]

The beginnings of the next sub-period IC is also marked by a thin levelling of light brown soil. This layer is also much trampled and compressed. From the surface of this layer a double line of post-holes were excavated, which, Allchin is of opinion, indicates that the stockade was of considerable strength.[265] Outside this line of post-holes, there were traces

of a corresponding layer, less trampled and quite unburnt, containing some cultural debris.[266] Inside the stockade there is a thick accumulation of ash, representing another deposit of burnt cow-dung. It is of interest to note that just beside the stockade, a shallow pit was scooped up beneath the layer of ash, which contained an infant burial.[266] The layer 8A outside this stockade contained a human occupational debris which may correspond to the interior cattle occupation.[267]

The succeeding periods II,[268] III[269] and IV[270] need not be discussed in details, suffice it to say that they yielded the same evidence of post-hole lines indicating stockades, surfaces trampled and bearing marks of cattle hooves, and cycles of burning cow-dung from all the levels. The cultural debris, outside the stockades contained pottery, stone equipments and bones of animals, especially cattle. The above evidence of structural and occupationals features at Utnur makes one thing quite clear that there ran a recurrent cycle of successive construction of trenches and stockades and burning of the layers represented by ash accumulation, which was analysed and proved to have been cow-dung. The remains of cattle bones in large numbers, intact impressions of cattle hooves, all point to the obvious occupation of cattle and probably a few goats, the remains of which were also recovered from the site,[271] inside the stockades. The human occupational debries outside the main line of post-holes surrounding the trenches, suggest human occupations surrounding these stockades. The recurrent feature of burning presents a puzzle to archaeologists and scholars. Such widespread and cyclic order of burning could not have been accidental. However, be that as it may, the above evidence in conjunction with the fact that large numbers of cattle were kept in these trenches.

Now, we come to the remains of animals recovered from the site. The excavations produced a large number of animal remains of which the vast majority belongs to the cattle and a small number to goat and deer.[272] From period IA come forty-seven fragments of cattle ; from period IB - thirty two ;

period IC — twentytwo ; period II — forty four ; period III —twenty eight ; period IV — twenty three.[273] The specimens of goat all come from period IA.[274] The fragments of deer probably belonged to a late date.[275]

The cattle, in general, represent the normal *Bos indicus* as at Piklihal and Maski and appear to be the ancestors of the modern cattle of the region.[276] Moreover, the hoof-impressions of the animal recovered intact from the floor of the trenches in the ash-mound were seen to be as large as those of the largest cattle in the modern village of Utnur.[277] The goat remains belong to the normal domestic type.[278]

The study of cattle bones from Utnur, however, provide some interesting ideas. Dr. P. Srinivasan, who analysed the faunal remains, puts forward that among the cattle bones from Utnur, a proportion belongs to adults of a noticeably smaller size than the majority.[279] F.R. Allchin suggests that this may indicate the presence of two distinct types of cattle at Neolithic Utnur. One resembled the lightly-built milch cattle of the modern Deccan. The other, heavier, larger, resembling the breed now used for transport and ploughing in the region.[280] We have already noted the existences of two different types of cattle at Maski and Piklihal, one a shorter, heavier variety and another lighter with long horns. Allchin infers that the enclosures at Utnur may have contained a hard of eight hundred to a thousand beasts or rather cattle.[281]

The ash-mound site of Kodekal lies about five miles north of the river Krishna in the Shorapur Taluk of the Gulbarga District in Karnataka.[282] It is situated in a valley enclosed by hills, supporting large open pastures. The typical thorn and scrub vegetation is encountered here.[283] An intermittent hill-stream flows by its eastern side.[284]

Excavations made by K. Paddayya provide interesting evidences regarding our subject. The stratigraphical scrapings at this mound revealed three periods of neolithic occupation, of which two experienced large-scale burnings as at Utnur.[285]

A carbon sample obtained from this site gives the date C 2335[286] B.C. which places the settlement at an earlier date than Utnur.

The scrapings exposed seven layers. The base of the mound is made up of moorum the compactness of which implies that it was specially prepared. Then follows the layer-6 composed of thick black-grey earth. The layer contains the earliest occupational debries consisting of pottery, stone artifacts and animal bones. At this level we also encounter artificially arranged stones. However, it is not clear whether they belong to any structure. This layer is followed by the laying of a floor of moorum which is followed by another occupation layer (layer-4), yielding pottery, stone artifacts, animal bones, charcoal etc. Above this layer we come across the first occurrence of burning at this site represented by a layer of thick accumulation of vitrified ash. we must note there that the previous layer-4 provide the largest quantity of occupational debris, proving a long period of occupation.[287]

After the stage of burning, where the absence of bands suggest that the ash was the result of single massive-scale burning, comes another layer representing human occupation. However here the occupational debris are rare implying a period of short duration. This third period of human occupation is again followed by a burning, indicated by layer of vitrified ash.[288] K. Paddayya accepts the results of the analysis done by Zeuner[289] regarding the nature and origin of the ash accumulated at ash-mounds in the Bellary District and points out that this may be the same in case of the ash at Kodekal.[290] He also puts forward that the large number of cattle bones recovered from the site again support this theory.[291] The faunal remains from Kodekal were examined by D.R. Shah which testified the presence of domestic animals like the cow, buffalo, goat, ass, dog and fowl and wild animals like the gazelle, spotted deer, Barasingha, rat and bony fish.[292] D.R. Shah reports that among the total faunal assemblage at the site, the bones of cattle far out-number those of the other species.[293]

All the animal bones from the earliest occupations layer-6 belong to the cattle, except one which belongs to the Barasingha. The subsequent Layers 2 and 4 also yielded large numbers of cattle bones.[294] The total evidence for cattle bones, therefore, suggest that it was the domestic animal herded by the earliest neolithic settlers at Kodekal. D.R. Shah points out that the presence of the neural spine of thoracic vertebrae of cattle at Kodekal indicate the presence of the Indian humped variety at the site.[295] She also points out that the size of the animal varied from a lightly built to a well-built animal.[296] We cannot be certain whether this variety in size indicates the presence of two types of cattle. However, we must mention here that we have noted a similar evidence at Utnur. The evidence from Piklihal and Maski representing different types of cattle again comes to the mind. Some of the cattle bones recovered show signs of having been chopped or split open in order to facilitate the extraction of marrow. This proves that beef was consumed by the neolithic folks at Kodekal.[297] Among the other domestic animals, remains of goat come next to those of cattle in quantity. The animal is represented by only ten fragments of bones, all coming from the layer-4 in Trench-1.[298] the Indian domestic buffalo is also represented by a few fragments coming from the same layer in trench-1.[299] Only one fragment of the fowl has been recovered from the same layer.[300] D.R. Shah mentions that the meat of buffalo, goat and fowl were also consumed by the people at the site.[301] However, these species arrived later than the cattle.

Apart from these animals associated with the diet, there were the remains of the dog[302] and a fragment belonging to the domestic ass,[303] both recovered from layer-4, Trench-1. It appears that the Equus species was present, if rarely, in the neolithic South India.

At Kodekal, therefore, we find that animal husbandry began quite early, before the date C 2335 B.C. which was obtained from a charcoal sample recovered from the layer-4.[304] But this early husbandry began with only the cattle. As

time progressed, newer domestic species were introduced in the economy. However, the predominance of cattle was a continuous feature. This animal perhaps both enriched the diet and served as a means of transport quite widely. At Kodekal the presence of the dog and ass is quite interesting. These two animals are not very common in the neolithic South India, However, at the settlement site of Brahmagiri, the neolithic contexts period IA yielded the remains of *Equus* species as we have already noted. The period IB at Brahmagiri has yielded the remains of the domestic dog, *Canis familiaris*. L. as Bhola Nath reported.[305] D.R. Shah suggests that the dog may have been a stray animal or was kept as watch dogs.[306] It has not been suggested whether the animal could have been used in herding cattle and goat.

We have seen that it is layer-4 in Trench-1 which yielded the largest number of animal bones studied so far at Kodekal.[307] This implies a development of the pastoral economy to its height around C 2335 B.C. — a radio-carbon date which comes from this layer. We find that the people here began with cattle herding and reached the stage of mixed animal husbandry with both the purposes of food, transport and other works in mind.

The Gaudur ash-mound lies just north of the Gaudur village in the Raichur district of Karnataka.[308] It was the ash from this site that was first reported by Foote.[309] F.R. Allchin points out that the sequence of layers at Gaudur resembles the features encountered at Utnur. Kudatini and also Kupgal.[310] Among the cultural debris, Munn mentioned the presence of long-bones of cattle.[311] Later, Allchin came across a box containing cultural debris from Gaudur as well as some objects from the ash-mound site at Wandalli which is now kept among the Indian collections of the School of Oriental and African Studies of London.[312] In this, Allchin came across quite a few animal bones all of which belong to the cattle or Bovine group, as he put it.[313] even among these bones we see that bones of small adults and those of a large size are distinguished.[314]

Evidently two types of bovine species were present as at Utnur. Of these two distinct breeds, Allchin mentions that one was a great, heavy version of Bos indicus, the other a much smaller and lighter animal, perhaps the ancestor of the modern smaller breeds.[315]

Besides the above-mentioned ash mounds, numerous others were found scattered in the Bellary, Raichur and Gulbarga Districts in the Karnataka and Mahbubnagar District in Andhra Pradesh.[316] A. Sundara[317] has come across additional numbers of ash-mounds in the Belgaum, Bijapur, Gulbarga, Raichur and Bellary Districts in North Karnataka while Rami Reddy has discovered a number of ash mound sites in the Anantapur and Kurnool districts in South Western Andhra Pradesh.[318] Now, we have already noted that F.R. Allchin had concluded, on the basis of his findings at Utnur, that the neolithic ash mounds in South India represented ancient cattle-pens.[319] In his words, "The ash mounds are great masses of burnt cow-dung which upon excavation reveal lines of post-holes making ancient stockades : they are in fact the pens in which the Neolithic cattle were herded."[320] And again, "Generalising from our excavations at Utnur, we may infer that the other ash mounds also represent the sites of Neolithic cattle-pens."[321]

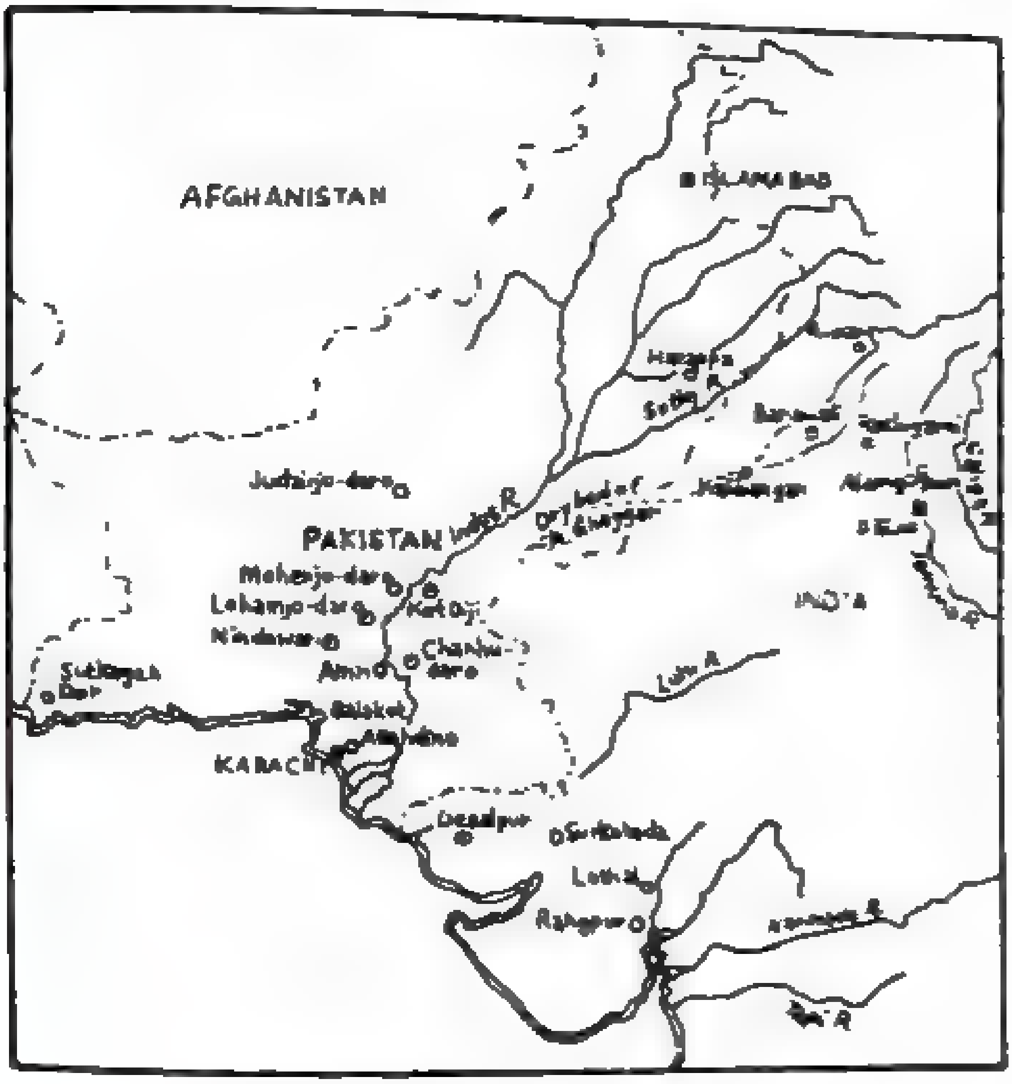
Allchin also points out that some of these ash mounds were found near permanent habitations and some far away from them. This pattern according to him implies that the cattle were sometimes penned at or near the settlements and sometimes far removed from the settlements, the second group representing a pattern of seasonal migration of the pastoral folks with their herds to areas which offered good pastures as well as adequate water supply. He points out the similar pastoral practices of the modern Todas in the Deccan region and compares the ancient pattern with the modern.[322] Moreover, at Utnur there is a clear indication of the provisions for the cattle in the inner stockades as indicated by hoof imprints, and the habitation of the men or rather herdsmen in the outer area, guarding the herds.

More recently, as we have also pointed out, the Allchins have slightly modified their theory of cattle-pen under the ash-mounds. Now they have come up with the theory that some of the ash-mound sites like the one at Utnur may represent the structures of a 'Keddah', or trap to capture big, wild animals.[323] They point out that the strong double fence, marks of which were encountered at Utnur, was at every period rather unnecessarily massive for simple cattle-pens.[324] A thorn fence or light bamboo fence as well as small bon-fires lit at night could have kept the wild animals at bay and restricted the movements of the already domesticated animals.[325]

However, if wild cattle were to be driven in traps and kept there under restriction in order to be tamed slowly, then obviously strong and massive fencing would be required. The Allchins point out that the shape and size of the Utnur enclosure conform closely to the description of the 'Keddah'[326] of the last century in Mysore which were used for capturing wild elephants.[327] Moreover, the wild cattle, after the initial capture, was to be kept penned continuously for a long time, in order to tame them. The Allchins point out that this would account for the huge accumulations of cow-dung at the ashmounds.[328]

Now we come to the observations made by K.R. Alur on the osteological evidences from Utnur. The Allchins point out that Alur has observed patterns of medullary cavity in the bones of neolithic cattle, especially from Utnur.[329] We have already seen above that the existence of the medullary cavity in the bones of animals indicate that the animal was as yet not fully domesticated.[330] Moreover, as we have noted above, at Utnur, Kudatini and Gaudur there was a variation in sizes of adult cattle, one group remarkably larger than the other. As we know, a pattern of size diminution is a mark of domestication of animals, especially sheep, pig and cattle. The larger size of some cattle may indicate that these were of a wild variety. While the shorter variety may have been domesticated. This is also supported by Alur's findings of anchylosis of hock joints in

THE MATURE HARAPPAN SITES



Map of sites of Mature Harrappan Period

MAP - III

case of cattle remains at Utnur.[331] This indicated that a group of cattle at Utnur had been put to heavy works of carrying burden and providing transport. Thus it seems that at Utnur both a wild and domestic varieties of cattle were kept. It has been surmised by the Allchins that the wild cattle captured and penned at the Utnur stockade were tamed with the assistance from an already-domesticated group of cattle.[332]

The Allchins therefore suggest that at the neolithic ash-mound sites we get interesting evidences for local domestication of wild cattle.[333] However, they do not dismiss the possibility of the sporadic diffusion of tame cattle into South India from outer regions, especially from the Indus plains, Gujarat and the margins of the Thar desert.[334] So, the Allchins conclude that the ash-mounds may represent ancient traps or Keddahs for capturing wild beasts while some may have represented cattle-pens associated with seasonal migrations and forest grezing of the neolithic herdsmen and herds.[335]

Next, we pass on to the artistic evidences from the South Indian neolithic context. The rocky hill tops above the neolithic sites of Maski,[336] Piklihal[337] and Kupgal[338] in the Bellary District of karnataka couches instances of bruisings and paintings. Though there is apparently no clear demarcation that all the rock bruisings belonged to the Neolithic period, however. some evidences helped F.R. Allchin to make the suggestions that a number of them actually do so.[339]

First of all, F. R. Allchin found that a number of hills which could have been suitable sites for rock-paintings and bruisings and had no neolithic settlement nearby, actually did not boast of such artistry. On the other hand, most of the hills bearing such marks of art, harboured neolithic settlements. Consequently, the idea springs to mind that some of these examples of art may actually be ascribed to the neolithic folks.[340]

However, in some of these areas the tradition of bruising, engraving or painting on rocks survived till the

present times, and here it becomes difficult to distinguish the old examples from the more recent ones. Here, the style and subject matter of the painting or bruising give clues as to their age. An efficient study of these and a careful scrutinising of the palimpsest layers lead one to the original neolithic contributions to these examples of art on rocks. Thus, F.R. Allchin points out, one can discern a group of bruisings beneath the more recent examples, bearing a distinctive style, belonging to the Neolithic period, in the hill tops around Kupgal, Piklihal, Maski and a number of other sites.[341]

The subject matter of the oldest group of bruisings consist mainly of bulls and also some human figures. Hunting scenes were also very popular. Interestingly enough, the bull depicted in the earliest group of bruisings is generally of the same variety as the terracotta bull figurines from Piklihal, mentioned above, i.e., with delicate feet and legs, shapely body and hump and very long curving horns.[342] Only one example from near Maski, perhaps may be said to have not represented as long-curved a horn as the general variety depicted in rock Bruisings.[343] At Kupgal the bruisings depict humped bulls, ducks, a human figure and several indistinct motifs of symbols.[344] At Tekkalkota, H.D. Sankalia reported the depiction of a bull and a hand on rock.[345] At a granite hillock, locally called Katti Banda, near the village of Hebbal Busurg in the Shorapur Taluk of Karnataka, K. Paddayya has come across some bruisings.[346] The figure of bull here quite matches those from Piklihal, Billamrayan Gudda, and one variety from Maski. The animal is shown with a elongated body and a raised tail, the horns and hump prominent and curving backwards. In case of the second bull depicted here the horns are not clear.[347]

K. Paddayya also noticed further bruisings at a short distance from the Katti Banda hillock. Here the subject matter consisted of three more bulls.[348] These bulls are slender bodied and generally resemble those at Piklihal[349] and Palavoy.[350]

They differ considerably from the depictions of bulls at Kupgal where the animal is shown to be rather plump and the horns rise almost vertically.[351] K. Paddayya states that although there is no sure way to determine whether these bruisings blonged to the Neolithic period or not, yet, their closeness to the Neolithic sites in South India, the weathered nature of the rock surfaces on which they are executed and the prominence of cattle as a subject-matter which was the mainstay of the economy of the culture strongly indicate their having been associated with the Neolithic culture in South India.[352]

Apart from these there are numerous artistic depictions of domestic animals, especially cattle, on the potteries and in terracotta of most of the South Indian neolithic sites. For example, a grey-ware lid from Tekkalkota depicts a peacock, serpent, ibex and bull. A terracotta toy bull[353] was also recovered from the site. The Piklihal bull figurines have already been mentioned. From Sanganakallu also terracotta bull figurines were recovered, the bulls resembling the one represented in the rock bruising near the site.[354]

From the above evidences it becomes apparent that the Neolithic people in Southern India were avidly practising the techniques of animal husbandry as a regular occupation. It also becomes quite clear, as Paddayya states, that cattle was the major animal which served the basic requirements of their life and economy. At all the sites the animal is represented in the largest quantity. Moreover, its importance loomed large in the psychology of the society as its numerous artistic depictions reveal. In this one feature we find a common psychology working both here and in the North-Western neolithic contexts although the form of expression may not have been exactly the same. What is most interesting here is that we often find at a large number of sites that cattle is the only animal whose remains could be recovered. It goes to show that the animal perhaps often bore the whole brunt of economic and dietary requirements of people at some sites,

with the exclusion, of course, of the games and food hunted and gathered by the people. The bones of cattle from most of the sites show clear marks of cutting, splitting and chopping. Some are even charred, indicating their use in human diet. Recently, K.R. Alur has pointed out that he has noted exostosis or bony growth in the animal bones recovered from Palavoy,[355] which are the result of concussion produced by heavy works. We have already mentioned above that he has noted similar features among the cattle bone recovered from Utnur. Recovery of exostosed animal bones are also reported from Hallur.[356] These are sure indications of long period of animal domestication and utilisation of the tamed animals in multifarious ways, especially in transportation. From the several sites mentioned above, our discussion shows, that while the evidences from neolithic village settlements amply justify the view that a mixed-stock animal husbandry was quite a common and important occupation of the neolithic folks here, the ashmounds indicate specialised herding. Besides cattle, the other animals domesticated at the village sites were sheep, goat, pig, ass, fowl and buffalo, the last three rather less common than the others. Remains of dog have also been at some sites, although the animal is not very common in this context.[357] But the ashmound sites reveal a predominance of cattle, Specialised herding of cattle may indicate a link with communicating operations.

We may conclude that by the end of the neolithic times,[358] Southern India was settling down with a farming economy, animal husbandry having attained a full development. The evidences from the ash-mounds, especially, Utnur, give interesting indications as to the actual practices of capturing, taming, penning and grazing of domestic animals, especially the cattle. Significantly, in the South Indian neolithic context the features of seasonal migrations with herds of cattle for grazing was a common technique practised.

III

PRE-HARAPPAN AND EARLY HARAPPAN EVIDENCES

The regions of Baluchistan, Afghanistan and Sind had progressed on the road of full-fledged sedentary life with subsistence food production already in the neolithic context, as we have seen. It would now be of interest to see how the Pastoralists were faring here in matters of animal husbandry in the Pre-Harappan context that set the stage for the Mature Harappan experience.

Around the first half of the fourth millennium B.C. a settlement sprang up in South-east Afghanistan at Mundigak.[359] Situated in a mountainous region, north-west of modern Kandahar, in the upper drainage of the Kushk-i-Nakhudrud, a tributary of the Arghandab river, the site had distinct ecological advantage in an otherwise semi-arid region.[360] Here we find that the settlers were utilising cattle, ass, horse (?) and even dog from the initial phases of period I.[361] It is of interest to note that from period I_2 onwards metals made their appearance[362] and from period I_3 onwards huts with *pisé* walls gave shelter to the people.[363] The pottery was a buff-red ware.[364] Terracotta figurines of humped bulls begin to come from period I_3-I_5 in increasing numbers. Two figurines resembling the goat were also recovered.[365] Cereal cultivation is also attested.[366] The C 14 dates for period I are : period I_2 - I_3 - 3745 B.C., and period I_5 - 3375 B.C.[367]

As time progressed the settlement at Mundigak began to flourish to great extents and by the period IV the site witenessed a remarkable degree of building activity as well as allround cultural developments. J. M. Casal designated the period as the 'Epoch of the Palace, which was characterised by monumental structures.[368] We may note that from period II and later periods, the same domestic animals, as mentioned above, are reported.[369] It seems that the technique sufficed to meet the ever increasing demands for animal protein at the evergrowing

site of Mundigak. However, one factor is doubtful here, that is the presence of the domestic horse. It should be noted that this animal was listed with the non-domesticated fauna in the Aceramic Neolithic context at the Aq Kupruk sites. In view of the total evidence for horse in the Indian subcontinent the domestication of true horse at Mundigak is doubtful. At Mundigak the picture of cultural progress and associated evidence for the food-economy leaves no doubt as to the important role of animal husbandry in a developing order. The artistic representations of domestic animals like the bull and goat indicate an awareness of the socio-economic significance of these animals in every day life.

The smaller sites of Deh Morasi Ghundai[370] following closely the settlement at Mundigak in point of time, and Said Qala Tape,[371] emerging a little later, also provide evidences that leaves no doubt about the fact of animal domestication. L. Dupree had reported the presence of sheep/goat and large bovid bones from Deh Morasi Ghundai.[372] However the faunal assemblages from both the sites have not been properly analysed as yet. Nevertheless, Shaffer points out, there is no doubt that the occupants at both Said Qala and Deh Morasi were exploiting domestic animals like, sheep, goat and cattle.[373] One radio-carbon date is available for period II b at Deh Morasi Ghundai, viz., C 3200 B.C.[374] Three dates are available for Said Qala, viz., period I-2110 B.C., period II-2160 B.C. and period III-2230 B.C.[375] Thus south-east Afghanistan witenessed the emergence of a food-producing folk from the middle of fourth millennium to the middle of the third millennium B.C. The smaller sites, lying near Mundigak in an alluvial plain of Sarawan, perhaps served as villages to the town at Mundigak.

Baluchistan, after the neolithic experience, was no doubt fully in the throes of growing farming economy where pastoralism was indeed a prime factor. This is very much reflected in the numerous artistic depictions of the domestic animals, especially the bull/cow, that begin to come in greater numbers

from several sites. Terracotta figurines of humped cattle come from Damb Sadaat, ten miles south of Kili Ghul Mohammad;[376] from periano Ghundai in the Zhob Valley in the extreme north of Baluchistan,[377] from Rana Ghundai in the Lorali Valley.[378] At Rana Ghundai the bull became a common art-motif for the painted pottery.[379]

The Nal and Kulli cultural sites in southern Baluchistan, also yielded similar terracotta figurines of the bull/cow. Sohr Damb, the site of Nal, a little to the north of the Porali river, yielded numerous terracotta figurines of the humped bull and a figurine of ram.[380] Pottery from the site depict the humped bulls, cows, the Sind ibex etc.[381] The site of Kulli in the Kolwa region also yielded several terracotta figurines of bulls.[382] From Mehi in the Mashkai Valley painted motifs of bulls and large-horned mountain sheep or goats are noted on the pottery.[383] The Kulli pottery from Nindowari display 'Animals in landscape', where the bull is the most represented animal.[384]

The popularity of the cattle as a domestic beast was no doubt quite evident. At the base of this growing preference for cattle was the gradual development of the agricultural economy and a shift of the pattern of settlements towards the river plains in southern regions. Sur Jangal, a site in the Loralai valley, lying in the midst of the narrow Baghnao Valley,[385] provides very interesting information as to this gradual shift towards the southern river plains, agriculture and cattle. The faunal assemblege here reveal that the remains of the cattle far outnumber those of sheep and goat.[386] The potters at Sur Jangal created some wonderful vessels depicting both the humped and humpless cattle. All of these exhibit wide-spread horns.[387] It may be assumed that this small village was inhabited by a people who were primarily cattle-raisers. As W.A. Fairservis points out, this point to a major economic shift.[388] For, so long we have noted that at the northern sites in Baluchistan and Afganistan the people were raising herds of sheep, goat and cattle, and nowhere, except at Mehrgarh, was there substantial evidence to indicate that cattle was in over-

whelming majority. Fairservis also points out that the emphasis on cattle. (a trait more noted in southern sites in the plains). at Sur Jangal an essentially northern site, suggests adaptations of cattle herding in the ecology of a typical upland valley as well as a gradual shift of the population towards the Indus river plain.[389] The pastoralists at Sur Jangal may have moved to and fro with their herds of goat, sheep and cattle between the hills and the plains below.

This shift of population towards the Indus Plain has already occurred earlier as noted in case of Gumla in the Neolithic context. Life at this site entered the chalcolithic era with the appearance of bronze tools in period II.[390] Practice of agriculture is indicated by the presence of storage jars and sickle blades of stone.[391] At Gumla we encounter terracotta figurines depicting two varieties of bulls, viz., the short horned variety and the humped bull.[392] Figurines of dog and some birds have also been recovered.[393] The C 14 date from the earliest layer of Gumla II is C 2798 B.C. (with MASCA corrections).[394] But what is of remarkable significance is the occurrence of terracotta wheels and toy carts[395] as early as the first half of the third millennium B.C. This may indicate that the use of domestic animals, especially cattle, for drawing wheeled vehicles had already commenced.

The Amri cultural sites had already emerged in the region around Lake Manchhar - Western Nara (of Indus) - Lakhi hills - Bandhni river. A number of small sites like the Ghazi Shah, Damb Buthi, Pandi Wahi and so on made their appearances as villages.[396] At Amri, the main site of this culture, lying 130 Kms. south of Mohenjodaro, in a semi-hilly region, on the western bank or the Indus,[397] we note the same predominance of cattle (Bos taurus) in the faunal assemblages or period I. Other domestic fauna include the sheep, goat and donkey or ass.[398] The Amri pottery also depict the cattle motif. Four such depictions occur on the pottery of period I-D which show long horns and prominent humps. Such depictions of the cattle continue to occur on the pottery again from period IIB on-

wards. The motif always bears a prominent hump and horn.[399] The terracotta figurines of the cattle that have been recovered represent both the humped and humpless varieties.[400] We may note that the faunal assemblage most probably yielded the remains of the humpless Bos taurus. Hence, it is probable that in this region both the humped and humpless cattle had been domesticated. Indeed the total evidence (from the Neolithic Phase onwards) makes it clear that both these varieties of cattle had been domesticated in the Indian subcontinent. Some radio-carbon dates for Amri are, 2665± 110, 2900± 115, 3406± 137 and 3334± 77.[401] The MASCA corrected dating. However, takes the beginning of the settlement to C 3700-3000 B.C.[402]

Further south from Amri, at Bala Kot in the Las Bela Plain we find a situation similar to that noted at Amri. Here also we note that in the Pre-Harappan or 'Balakotian' levels although there is evidence for a mixed-stock herding, the cattle predominates the scene. It makes up about seventy-five percent of the total mammalian remains recovered from period I.[403] The cattle was perhaps of the zebu or humped variety.[404] Other domestic fauna represented were sheep, goat, pig and half-ass.[405] The picture of the economy is quite similar to that noted at Mehrgarh and Amri. R.H. Meadow, who studied the faunal remains from the site points out that the overwhelming number of cattle remains at Balakot suggests a nearly complete dependence of the pre-Harappan population on this animal.[406] The picture would change in the subsequent Harappan period, as we shall see.

Now, the Khurkhera plain where Balakot is situated (about 16 Kms, inland from the Arabian sea coast) receives very little moisture. However, the Winar river floods in the monsoon and leaves heavy deposits on the plain,[407] providing good forage for the domestic herds, especially the cattle. Meadow points out that the pre Harappans grazed their cattle-dominated herds in the alluvial areas in the immediate vicinity of the site.[408] The plains in Baluchistan and Sind were thus witnessing the

development of a mixed stock herding comprising the cattle, sheep and goat, where cattle dominated the scene. The half-ass or hemione had also been taken into the fold of animal husbandry by the herdsmen in these regions.

Away from these regions, at Jalilpur in Punjab we find no major alterations in the pastoral economy. Jalilpur, situated on a former flood-plain of the river Ravi, about 74 Kms. south-west of Harappa,[409] yielded the remains of such domestic animals as the cattle, sheep and goat throughout the two occupations at the site,[410] period I (pre Harappan) and period II ('Kot Dijian' or 'Early Harappan').[411] However, as R.H. Meadow reports, out of the total 329 faunal specimens recovered and analysed from the site, only 12 come from the contexts definitely belonging to period I (late fourth millennium B.C.).[412] However, a lot of faunal material from the site have not yet been studied[413] and only after this is accomplished can we have a clear picture of the state of animal husbandry in this context at Jalilpur.

R.H. Meadow who has examined the faunal evidences from the three sites — Mehrgarh, Balakot and Jalilpur, makes some general remarks about these.[414] It should he noted that these sites belong to three different geographical regions, viz., Mehrgarh in the Kachi Plains in Baluchistan, which is a triangular shaped and very gently sloping alluvial tract lying between the Kirthar and Suleiman mountain ranges and the main Indus valley, Balakot, in the coastal region of the Arabian Sea in the arid Las Bela Plain which is relieved by the Windar river running through it ; and Jalilpur in south-western Punjab on the banks of Ravi. Meadow points out that at all these sites the sheep, goat and cattle were being herded with zeal, a marked preference being shown to the cattle.[415] The form of cattle most common was zebu[416] as is indicated by some osteological evidences as well popular artistic depictions of the humped bull. A hint of diminution of cattle has already been noted at Mehrgarh.[417] sheep this trend is quite remarkable at all sites, especially Mehrgarh and Balakot.[418] However, there is

little change in the overall size of goats.[419] Another factor to be noted is the shift of emphasis from goat to sheep, especially at Mehrgarh.[420] R.H. Meadow points out that once sheep and cattle breeding proceeded importance of the goat diminished.[421] It should also be remem-ed that sheep and cattle were the most valued domestic animals in an agricultural society.

Thus we get a clear picture of the standards reached by the early pastorolists in a wide geographical region, covering Baluchistan, Sind and Western Punjab. The evidences from Afghanistan give similar pictures of a mixed-stock herding (goat, sheep and cattle) and the keeping of the half ass or ass for pack purposes. The bull or ox also served this purpose quite efficiently. It is also evident that there was an emergence of specialised herders in these regions, separate from the farming folks, as the evidences from Sur Jangal indicate, who migrated with their herds to and from between plains and mountains. The gradual predominance of the cattle in the pastoral economy is a sign that indicates the movement of population down into the river plains in the Indus Valley, and the adoption of large scale agricultural activities. This was the situation by the end of the fourth and the beginning of the third millennium B.C.

It was around this time that the Sothi cultural sites had made their appearances in the plains of the lost Saraswati river and along the Ghaggar-Hakra bed.[422] However, nothing definite can be said about the economy of these early (pre-Harappan) settlers here from the meagre evidences available, which mostly consist of ceramics, viz., the 'Sothi Ware'. M.R. Mughal's explorations in Cholistan, along the now-dry river bed of the Hakra or Sarasvati river led to the discovery of a number of pre Harappan sites which yielded a common pottery designated by Mughal as 'Hakra Ware'.[423] At these sites, Mughal came across terracotta figurines of animals with short, joined legs, including those of bulls of cows.[424] Mughal relates the Hakra Ware period with Jalilpur period I sequence and dates it approximately around the fourth millennium B.C.[425] Thus, it appears that the cattle was a familiar animal

even east of the Indus and had perhaps been domesticated in the Sarasvati Valley too.

Around the beginning of the third millennium B.C. a new development begins to become apparent in the greater Indus region, which was a natural outcome of the cultural growth of the previous periods in these regions, so far noted above, and which now formed a formative stage underlying the Mature Harappan (urban) Civilisation of the middle and late third millennium. This new phase has been designated 'Kot Dijian' after the type site of Kot Diji in Sind, or 'Early Harappan'.[426] This phase was marked by a spurt of building activities and the occurrence of the 'Kot Dijian' pottery. M.R. Mugal ascribes this designation to the Kalibangan period I occupation, Jalilpur period II, Gumla II, Siswal A and Mitathal I.[427] It would be of extreme interest to note how the economy of animal husbandry was progressing in this new cultural environment.

Kalibangan, located on the southern bank of a now-dry course of the Ghaggar, in the Ganganagar District of northern Rajasthan, witnessed the emergence of a rich settlement around C 2900 B.C.[428] which was characterised by fortifications of mud-brick structures, the practice of the English bond masonry, a rich variety of ceramics, terracotta objects, beads of semi-precious stones, copper objects etc.[429]

As to the economy of the pre Harappans at Kalibangan, the practice of agriculture is attested to by the existence of an extremely interesting piece of evidence, viz., the remains of a five thousand years old agricultural field with some of the ploughed furrow marks intact.[430] We do not come across reports of faunal remains from the levels of this period I. However, B.B. Lal and B.K. Thapar report the discovery of terracotta bulls and toy-cart wheels,[431] indicating the possibility of cattle herding as well as the utilisation of the bull or ox for drawing carts. B.B. Lal puts forward that the pre Harappan inhabitants at the site practised cattle-breeding along with agriculture.[432] B.B. Lal points out that the recovery of the

terracotta cart-wheels and bull figurines indirectly indicate the use of bullock-carts in the pre-Harappan town of Kalibangan. He mentions that the northern opening of the fortified area had a wide entrance and suggests that through this such vehicles had passed frequently and went into the settlement through sufficiently wide streets.[433] The pottery of these people also exhibit animal motifs, including the stag, bull, duck etc.[434] In some cases the fowl had a also been depicted.[435] However, the domestication of fowl is not certain, while that of the cattle has already had a very long precedence and there can be no doubt that the animal was being exploited by the people here. The pre-Harappan occupation at Kalibangan ended somewhere around C 2700 B.C.[436] The socio-economic conditions were extremely advanced as is evident from the well-laid-out town, and the evidence for plough agriculture. The economy of animal husbandry must have played a major role here. Attention was most probably given to dietary requirements as well as the need for transport and draught in a fast growing community, where trade and commerce must have grown rapidly to warrant a semi-urban milleu.

Meanwhile, around the beginning of the third millennium, the site of Kot Diji, on the east bank of the Indus river in upper Sind, was also witnessing the first stirrings of an incipient urban life. A massive defensive wall of limestone rubble foundation and mud brick strengthened by bastions, house walls of mud brick, large brick-lined ovens, etc. signify this experience.[437] However, there are no direct evidences for either agriculture or animal husbandry. Stone sickle blades[438] and a solitary fine-modelled terracotta figurine of bull[439] are the only probable indications of agriculture and herding. The C 14 dates available from Kot Diji are : C 2880 B.C. — from near the beginning of the early settlement ; C 3180 and C 2700 B.C. - from near the top of this level ; and C 2520 B.C. from the end of this period.[440]

The first half of the third millennium B.C. also saw the emergence of the 'Early, Harappan' or 'Kot Dijian' occupation

at Jalilpur,[441] characterised by mud-brick structures, metal artifacts, the typical 'Kot Dijian' pottery, beads of lapis lazuli, shell bangles, female figurines etc.[442] We have already seen that among the total faunal remains studied by R.H. Meadow, only a very few come from the Jalilpur period I levels, the rest coming from period II. The faunal remains represent the domestic cattle, sheep and goat as well as some wild species and aquatic fauna.[443] Cattle dominates the scene constituting almost ninety percent of the samples studied.[444] However, Meadow reports that a brief survey of the material not yet fully studied reveal that sheep, goat and gazelle make up more than ten percent but less than twenty-five percent of the collection.[445] On the grounds of the report available, we may assume that the herds of domestic animal kept at the settlement of Jalilpur increased gradually through time from the early neolithic days to the 'Early Harappan' times. The cattle was the most favoured domestic animal. The alluvial soil around Jalilpur supported tropical vegetation and also semi-steppe shrubs which was quite ideal as food for the cattle kept by the settlers.[446] As Meadow points out, the population at Jalilpur, as at Balakot, were almost completely dependent on cattle and only marginally on smaller domestic mammals like the sheep and goat for animal protein in the span of time from late fourth millennium to the first half of the third millennium B.C.[447] Among other artifactual remains at Jalilpur period II levels were the terracotta toy cart-frames as well as wheels with protruding hub and humped bull figurines of both terracotta and copper,[448] indicating the probability that life-size wheeled carts drawn by draught animals like the bull were already traversing through these regions in Western Punjab.

Further north east, on the Potwar Plateau, in the Gandhara region, the site of Sarai Khola near the ancient city of Taxila, yielded the 'Kot Dijian' pottery from period II levels.[449] The earlier neolithic period I was characterised by a brown burnished ware.[450] We may note that so far, this is the earliest evidence of a cultural growth from the neolithic times onwards

in this region. The period II Levels witnessed the introduction of metal.[451] Marks of post holes and prepared floors of earth and 'Kankar' indicate mud huts of rectangular shape were erected.[452] Ceramic figurines of bull or cow and ceremic toy-cart frames have been recovered.[453]

Coming back to the Indus region, we note that the western plains in the Derajat region witnessed the emergence of the 'Kot Dijian' culture around the early days of the third millenium. Rehman Dheri period II levels (C 2600-2480 B.C.)[454] saw the development of flourishing life. The pottery from this context display some painted motifs that were later to become typical of the Mature Harappan civilization, like the peacock, interesecting circles, etc.[455] A number of unfinished beads of semi-precious stones as well as lumps of raw materials have been recovered, indicating that bead industry had developed in this context.[456] F. A. Durrani feels that the site might have been a major trade centre in the Gomal plains.[457] An unique ivory seal from Rehman Dheri II depict the figures of two mountain goats along with other motifs.[458] The faunal assemblage reveal the occurrence of cattle, sheep and goat.[459]

At Rehman Dheri, we get an interesting picture of a settlement of primarily crafts-men and probably traders who, nevertheless practised farming and animal herding. A coexistence of the economies of handicrafts and farming-herding, which was to develop later to fuller extent, is noted. A check-board pattern of the economic life emerges.

In the same region, in the Bannu basin, the site of Tarakai Qila grew up where the 'Early Harappan' settlement closely resembled that at Rehman Dheri in artifactual and structural features.[460] As the Allchins remark, the major mud-brick defensive walls encountered at Tarakai Qila as at Rehman Dheri 'are indicative of an incipiens urbanism'.[461] The presence of cattle, water buffalo, sheep and goat have been reported among the faunal remains.[462]

The pattern of the 'Early Harappan' culture extended east

wards, crossing over to the Indo-Gangetic Divide in the Sutlej-Ghaggar-Saraswati Valleys. The Bahawalpur region witnessed the emergence of this culture at almost forty different sites around the early third millennium B.C.[463] In the lost valley of the Sarasvati and the Drishadvati, the sites of Siswal A Ware culture and Siswal B sprang up. suraj Bhan, in the course of his explorations have come accorss sixteen sites of the Siswal A Ware (related to kalibangan I ware) in the south-western part of Haryana. He has marked this context between C 2300 B.C. and C 2100 B.C.[464] The Siswal B Ware has been recovered from thirty-two sites, mostly located in the Drishadvati and Yamuna Valleys. The Siswal B Sequence has been dated between C 2100 B.C. and 2000 B.C.[465] However, no evidence is available regarding the economy of animal husbandry, and, therefore, although the practice of animal herding cannot be ruled out in these contexts, we cannot make any difinite idea, as to the nature of the economy.

The site of Banawali, located in the Hissar District, Haryana, has yielded some evidences that may give indications of some sort . Terracotta animal figurines have been reported. Most interesting is the depiction of a canopied cart with spoked wheels in painting on a pottery sherd.[466] Houses were built of bricks, both fired and sun-dried, beads of gold, semi precious stones etc., and objects of copper[467] are the other features of the period I (Kalibangan Culture) at this site. This period of occupation may be dated between C 2500 and C 2300 B.C.[468] The high standard of life as evident at Banawali would surely warrant the use of elaborate wheeled vehicles drawn by domestic pack animals for transport of men and goods.

The above survey of the pre-Harappan and Early Harappan evidences for animal domestication reveals that the people inhabiting the regions west and east of the Indus Valley were exploiting a number of domestic animals, like the cattle, sheep, goat, and less often buffalo and pig for food requirements. They were also using a number of

species like the bull/or ass and half-ass etc. for transport. As new settlements were emerging rapidly and the population was increasing, demands for animal protein was like-wise increasing. The herders were making great efforts at meeting these needs. The higher standards of life noted from the pre-Harappan times onwards would call for busy commercial activities that would require efficient communications. In the early days of civilization in these regions (noted above), the wheeled carts drawn by cattle and asses were the best means of transport available. The ingenious people had already thought out these measures. Thus long distance overland trade was made speedier and easier. Now not only bulky goods but also a greater amount of goods could be carried from place to place. The times were witnessing the parallel development of agricultural economy in the regions of Baluchistan, Sind, and in Valley of the Ghaggar river. We noted a shift of the population to the great river valley of the Indus system. The predominance of cattle in the herding economy was a natural feature of this new development. The cattle which thrives on the grass and forage available in the river plains, was not only a good reserve of animal protein in milk and meat but also provided labour in the agricultural tasks as well as the sphere of transport. The preference for sheep also increased for sheep thrived better than goats in the plain lands. The appearance of pig at some sites also signify the commencement of full-fledged agricultural economy in real earnest.

IV

EVIDENCES FROM HARAPPAN CULTURE

Around the second half of the third millennium B.C. the Mature Harappan phase was ushered in. The sweeping upsurge of cultural progress over a wide region in the Indian subcontinent, from Makran in the west to Uttar Pradesh in the east, and from Punjab in the north to Gujarat in the south took shape in urban maturity. The Harappan culture,

named after the famous site of that context, can be indentified by the remarkable culture uniformity, viz., the standardised weights and measures, the common script, the gridiron plan of streets and buildings on platforms and drains, the standardised bricks, the typical ceramics, the common motifs on ceramics like the peacocks, pipal-leaves, or inter-secting circles, the copper-bronze metal repertoire, bone and ivory inlay, terracotta toy-carts and animal and female figurines, and the Indus seals. Lastly Walter Fairservis has stressed another interesting and common feature of the Harappan culture, viz., an emphasis on representation of cattle on seals and cattle figurines. We shall discuss the significance of this last feature in details later on in this chapter.

The Mature Harappan Phase witnessed the first experience of urbanisation in the subcontinent which was highly sophisticated and complex. Although the scholars are not yet decided on the question : to what particular experience this first Indian urbanisation owed its origin, yet more and more, the historians are seeking the origins of the Harappan urbanity in the local history just preceding the Harappan culture phase. As the Allchins point out, 'the search for some area outside the Indus System from which to derive' the Mature Indus style 'appears to be a chimera'. They voice their assumption that, 'at base the one must have evolved out of the other in the Indus Valley itself, implying a continuity of population and technical skills'.[469] Indeed, the ground was prepared by the technical and productive activities of the people locally which, as we have been discussing, has had a long precedence. The agricultural economy in these regions had to become strong and prosperous enough before it could lend support to an urban life where the elite were not engaged in any productive activity, where trade had become a very important economic feature, where masons, metal workers, potters, sculptors and scribes could continue to accomplish their specialised skills the products of which would interest the admirers of the distant future.

Most of the Harappan culture traits, as we have seen above, had rudimentary precedents in the pre-Harappan culture. The pre-Harappans had built permanent settlements in the riverine environment indicating that they had mastered the art of exploiting such an ecological environment. Moreover, we have seen that the pre-Harappans were already employing bullock-carts for trade and communication. The contribution and connections of the upland Baluchi cultures with the Harappans are also quite significant. The Baluchi nomads had long adopted animal husbandry as a means of sustenance and since time immemorial have been coming down seasonally to the river plains. When the urban civilization flourished on the plains, these upland village people still carried on their herding activities as well as small-scale agriculture and also served as moving links between different regions, facilitating trading activities.

Down in the plains the scale of life widened. The different cultural traits began to get assembled and form a distinctive texture named the 'Mature Harappan'. New developments in technology, economy and organisational structure marked this cultural growth. Everything had to be moduled and adjusted to this growing socio-economic and political situation. It is against this background that we have to assess the development of the basic techniques of agriculture and its appendage-animal husbandry — in the Mature Harappan context. We shall begin with an objective study of the evidences for animal husbandry at some of the more important and representative of the Mature harappan sites from different geographical regions.

Mohenjo-daro, situated in the Indus Valley near the right bank of the indus river, enjoyed a fertile outlying region, a luxuriant vegetation as well as a more compatible climate compared to the upland villages of Baluchistan that we have already surveyed. At Mehrgarh and Gumla we have already come across a situation similar to Mohenjo-daro and noted how those sites had flourished through a

great span of time, giving us a lot of significant evidences for animal husbandry.

The evidences from Mohenjo-daro regarding pastoralism are both numerous and significant. First, we must go through the osteological evidences regarding the state of animal husbandry that have come from this site. Col. R.B. Seymour Sewell and Dr. B.S. Guha made a thorough study of these materials.[470] About thirty seven different species of animals have been recovered. Several of these belong to the domestic category.[471] It ought to be noted here that the wild faunal remains at the site are quite numerous and the aquatic animal range very high in number among them. It appears that the people of Mohenjo-daro throughout all the stages of occupation had depended on some wild species like stag, spotted deer, hog deer, the gharial, tortoise and several species of fish for their diet.[472]

However, when we come to the remains of the domestic species we find that the evidences are quite substantial. At the very beginning we must note a very interesting feature of the faunal remains at Mohenjodaro, viz., the presence of the pig in a large number. The most overwhelming number of domestic animal species belong to the *Sus cristatus*, pig. This is interesting because the pig was never an important domestic animal at the earlier sites mentioned above. Sewell and Guha tells us that it is "impossible to determine whether or not this animal was actually domesticated or even whether it was used as a source of food by the inhabitants of Mohenjo-daro".[473] They also suggest that this animal might have served as scavenger, feeding on the refuse thrown away by the people.[474] However, this view of Sewell and Guha border on conservatism and cannot account for such a large number of remains, belonging to *Sus cristatus*. They constitute the largest number among the total remains of the domestic animals. Moreover, they come from all the levels excavated at Mohenjo-daro, from below 12 ft. to less than 2 ft. below the surface.[475] Such a uniform and large distri-

bution of pig remains is quite conspicuous and point to the fact that this animal must have become associated with the human beings living at the site. An association between man and pig at the ancient site is already suggested by Sewell and Guha. But it is impossible to believe that if pig only served as a scavenger beast, such a large number of them, largest among all domestic animals, could exist in the vicinity of the human settlement and remain unaffected by all other consequences of the human association, like domestication and the subsequent features pertaining to animal husbandry. This is so, especially since the pig produces a lot of meat and fat, breeds easily and proliferates rapidly. Indeed, it is very easy to keep since if feeds on human refuse and garbage and can be kept in small spaces near human settlement. We may assume that these possibilities also occurred to the inhabitants of ancient Mohenjo-daro. Incidentally, we may note here that Shri Bhola Nath has also listed the *Sus scrofa cristatus* Wanger, under the, list or animals probably domesticated at Mohenjo-daro.[476]

Next in quantity to the pig is the cattle *(Bos indicus)*. The remains of cattle come from the lowest levels to 2 ft. below the surface.[477] Only in the upper layers are they absent. The teeth of the cattle as well as a large fragment of the frontal region of a skull and a single right horn core from Mohenjo-daro were compared with corresponding parts of recent specimens of Bos indicus and were found to bear extremely close resemblance.[478] Sewell and Guha are opinion that the people at Mohenjo-daro had maintained a large herd of cattle at some stage.[479] They also point out that quite a number of teeth have been recovered at the site which belong to young cattle.[480] As we have already noted above, the remains of young domesticable animals at a prehistoric site indicates domestication. Sewell and Guha explain that the presence of young animal bones meant that they were slaughtered for food. They also think that this accounts for the total absence of a single complete long

bone belonging to *Bos indicus.*[481] We have already seen above, how gradually the cattle was becoming a very popular domestic animal in the region. There is no doubt that at ancient Mohenjo-daro the animal was extremely useful. Indeed, if and when the lower strata at Mohenjo-daro is fully excavated, we may get more information regarding the husbandry of at least cattle and pig, of which we find signs from the lower-most stratum excavated at present.[482]

The species *Bos bubalus bubalis*, i.e. buffalo, appears the scene at Mohenjo-daro at a level between 7 ft. and 2 ft.below surface.[483] Not a very large number of fragments of the buffalo are available and therefore, it is considered, that the animal may not have been very important economically to the inhabitants of ancient Mohenjo-daro. However, that the animal was domesticated is evident from the examinations done by Sewell and Guha, who found that the remains of Mohenjo-daro buffalo do not appear to differ appreciably from the structures of modern buffalo.[384]

If the profuse presence of pig at Mohenjo-daro, is of interest to us, so is the rarity of the sheep, *ovis vignei*, at the site.[485] We have noted the sheep as a quite important domestic species in most of the sites we have come across above. But, it was also evident that sheep and goat were more associated with the mountaineous and nomadic groups. As we come down more and more near the river plains we note the diminishing importance of goat and sheep and the increasing importance of cattle. At Mohenjo-daro goat has not been seperately indentified, sheep is rare, cattle is quite profuse. It is evident here that we are passing on to a higher stage of husbandry is a different ecological setting where agricultural activities were rampant. In such conditions the keeping of cattle perhaps proved to be more advantageous. Sewell and Guha noted only seven fragments of sheep at the site[486] all of them coming from the levels between 7 ft. and less than 2 ft.[487]

At ancient Mohenjo-daro the fowl had become quite a popular bird with the settlers. Some of the clay figurines of bird recovered at the site definitely belong to the fowl.[488] A few pieces of bones belonging to the fowl (*Gallus* sp.) have been recovered at a depth between 7 ft. and 2 ft. below the surface. These remains were examined by Sewell and Guha and were seen to be corresponding to the general structures of the domestic fowl.[489] However, we have already noted above that the Mohenjo-daro examples were considerably larger than the modern domestic fowl of Bengal as their respective measurements shown. Sewell and Guha could not come to any definite conclusion as to whether they were domesticated or wild.[490] However, the terracotta figurines as well as some bird cages may indicate that the bird might have been captivated by the people at ancient Mohenjo-daro. We may also that fowl may have constituted a part of the diet of the folks.

At Mohenjo-daro, Sewell and Guha have come across only one fragment which they indentify as belonging to the Indian one humped camel, *Camelus dromedarius*, at the lowest stratum, fifteen feet below the surface.[491] We cannot draw any definite conclusions about the exact status of the animal in the ancient society at Mohenjo-daro, although we accept the opinion of both Sewell and Guha[492] and Bhola Nath[493] that it belonged to the category of domestic animal at the site. We shall also come across this animal at Harappa, although even there the evidence is very scanty. It appears that only a very few specimens of camel existed in the region in the Harappan times.

The remains of dog at Mohenjo-daro appear between the depth of 7 ft. and 2 ft. below the surface.[494] The analysts are of opinion that the Mohenjo-daro dog belonged to the same group of semidomestic or domestic pariah that are common in India even today.[495] We have already gone into the details of its origin. We can assume the fact that since the remains of the animal have been found so near human

habitation, a symbiotic relationship between the dog and man might have been in vogue at Mohenjo-daro.

We must mention here that Sewell and Guha report two fragments belonging to the horse (Equus caballus) recovered from a depth of 1 ft. 10 in. below the surface at Mohenjo-daro. They also mention that in size the fragment of the jaw corresponds exactly to a skull of a modern horse in the collection of the Zoological Survey of India.[496] However, this stratum is related to a much later period,[497] corresponding perhaps to the Jhukar period.

At this juncture we must point out that, although Mohenjo-daro has yielded a substantial quantity of osteological evidences for the existences of both domestic and wild animals, yet this quantity may not represent the actual number of animal species existing at the site. Sewell and Guha mention that two factors may be responsible for the smaller number of animal remains at the lower strata at Mohenjo-daro. First, they point out that at this site and the surrounding regions the soil is impregnated with salt petre which rapidly causes deterioration and final decay of bony objects. Secondly, they point out that only a comparatively small area of the lower strata had been excavated at Mohenjo-daro.[498] A further excavation may yield more evidences regarding our subject. We have to keep these facts in mind while evaluating the evidences from Mohenjo-daro. However, as far as our knowledge goes at present, the levels from below 12 ft. to 7 ft.. below surface, yield a lesser variety as well as number of animal species remains than the layers between 7 ft. and 2 ft. below the surface.[499] Besides the reasons mentioned above, this may indicate a very natural growth and development of the economy of animal husbandry at the site from the early days to the mature ones when it attained a peak along with other socio-economic and cultural aspects of life at Mohenjo-daro.

Here we would like to examine some interesting

suggestions made by Bhupendra Pal Singh.[500] To begin with, he points out that except for pig no other domestic animal including cattle was adequately represented in the food debris at Mohenjo-daro. He goes on to say that "small number of cattle remains indicates that the occupants never had a luxuriant population of this animal in the entire history of the settlement".[501]

However, we have already noted the possible reasons advanced by Sewell and Guha for the scarcity of animal remains at the lower strata at Mohenjo-daro. Since the cattle remains begin to come from the lower strata onwards, these reasons may account for their smaller number at least at these lower levels. However, it is also true that the pig, the remains of which also come from the lower strata, was always more numerous than cattle, irrespective of these conditions and reasons. The reason advanced by Singh for this is that the people at Mohenjo-daro were not primarily cultivators, that they did not possess cultivation fields around the city, and cattle, an animal especially associated with a cultivating society, was, therefore, less in evidence.[502]

B.P. Singh also mentions the slaughter young cattle as surprising for a people who are supposed to be specialised in cattle breeding.[503] But, as we have already noted, this feature of killing young domestic species for food indicates domestication in prehistoric conditions and we have discussed in details why this was so. Here, we deem it necessary to stress once more that in pre-historic conditions animal husbandry had not yet reached the stage where stock-breeding had attained a prime place in the technique. The primitive pastoralists has not yet fully realised the importance of selective breeding of domestic species. So, at Mohenjo-daro the killing of young cattle does not indicate that the animal was not domesticated. It only indicates that the stage of husbandry has not yet reached its maturity. This was true not only is case of cattle, but also sheep and buffalo. Sewell and Guha also mention that at Mohenjo-

daro "there is a great quantity of bone of very young animals among the sheep and pig".[504] The same was true of the husbandry practices at most other contemporary sites. However, at Harappa the evidences indicate a more mature technique of animal husbandry being practised.

B. P. Singh very astutely draws our attention to the fact that the domestication of pig at ancient Mohenjo-daro from the lowest levels onwards is extremely significant and that the causes behind this should be examined.[505] It is really interesting that cattle and sheep were not as numerous as pig at Mohenjo-daro. B. P. Singh, we have noted, makes the suggestion that cultivation around Mohenjo-daro was not sufficient and the domestication of cattle, which depends on a flourishing agricultural economy was not sufficiently developed. He suggests that in these conditions the population turned to pig which provided enough meat and could be kept easily.[506] However, in the next chapter we shall see that this was not at all the case. The area around Mohenjo-daro was brought under cultivation in the mature days of the Harappan culture. In the circumstances, the overwhelming number of pigs may indicate that this animal was being preferred for it could serve meat to a large urban population better than the cattle. Moreover, cattle could not be kept inside the congested city with as much ease as the pig. Therefore, cattle was kept outside the town near the cultivation fields, while pig, kept near hand, was being killed and eaten. Only further excavations in the vicinity of the town may prove the point.

Besides the above mentioned osteological evidences for animal-husbandry, we come across a great deal of artistic representations of domestic animals from which we may draw support for many of our ideas. The Harappan artists at Mohenjo-daro executed several domestic animals on seals and amulets, potteries and into terracotta and stone sculptures.[507] Stone and terracotta figures of bulls were quite common. Mackay mentions a few stone figures of bull

and points out that they were principally models of a short-horned variety.[508] Numerous terracotta figurines of the animal were found at all levels from Mohenjo-daro. Infact the bull figurine had already become a very common and popular features of early and mature Harappan culture at most related sites. Several seals depict the animal in a variety of style and pose. We find both a humped and humpless varieties in these executions.[509]

Among the other domestic animals, the dog, ram, buffalo and fowl were the favourites with the Mohenjo-daro artists. Paintings on Harappan potteries, depictions on seals and terracotta works all represent these animals quite often. In fact, a lot of hypotheses can be made on the basis of these evidences. For example, the different terracotta figurines of dog at Mohenjo-daro have led John Marshall to conclude that there were probably two distinct varities of the animal at the ancient site. The first is a type closely related to the pariah. The second is a high-breed variety allied to the modern mastiff.[510]

Interestingly enough, many of the seals at Mohenjo-daro represent horned deities, the horns resembling those of goat or bull. Mackay is of opinion that the seal-amulets from Mohenjo-daro provide an overwhelming evidence of the worship of animals. These seals portray animals like the bull, elephant, tiger, buffalo, oxen and crocodile. We also suggests that most of these animals were kept in captivity for the great majority have a manger and food-vessel before them. In front of the urus-bull an object is invariably kept which is regarded by some authorities as an altar and by some as a crib for fodder.[511]

Besides these animal figurines, we come across certain artifacts that throw light on the conditions of animal husbandry. We have already discussed this category of evidence at length. Here we should note that a considerable number of pottery wheels and frames of toy-carts have been recovered from Mohenjo-daro. Mackay is certain that the

wheels belonged to the toy-carts and other such games. A restoration of the toy-cart frames revealed that this vehicle resembled a Sindhi cart of present times.[512] It seems that such carts traversed the streets of Mohenjo-daro in real-life so that toy-models of these had become popular probably with the children. These carts were drawn by the strong and big domestic animals like the bull, ox and buffalo at Mohenjo-daro.

Now, a general picture of the stage of animal husbandry reached at Mohenjo-daro is clear before us. From the earliest times revealed at the site, cattle and pig had played a part in the diet and therefore economy. The cattle was already used for transport purposes at the early period. We also have a lone example of camel from the lower strata which does not help us much to theorise about its exact status in the society. However, we shall find that it was present at Harappa[513] and at Kalibangan[514] in Rajasthan.

From the mature period onwards buffalo, sheep and fowl occured on the scene and enriched the faunal taxa at the site. Dog, a nonfood domestic animal also made its appearance. It is evident that the cattle, sheep, buffalo and most important, pig provided the people at Mohenjo-daro with animal protein in their diet. Some of these animals, for example, the bull, the camel and buffalo were also used for transport and carrying burdens. The evidences suggest that some these animals drew wheeled vehicles at and around ancient Mohenjo-daro. It is possible that caravans of these animals especially the bull and ox, were widely used for the flourishing trade and commerce in the urban environment of the mature Harappan period. The domestic pack animals had a very important role to play here. It should be remembered that it was in the strata between 7 ft. and 2 ft. below the surface that the varieties of species as well as numbers of each species represented increase.[515] It indicates that by the mature Harappan period the technique of animal husbandry had reached a particular height at Mohenjo-daro.

The people were endeavouring to attain mastery over this process. However, we note a decrease in the numbers of faunal remains at Mohenjo-daro at the layers between 2 ft. below and the surface.[516] This indicates a degeneration of the economic conditions at the site, as far as animal husbandry was concerned. These layers correspond to the late period at Mohenjo-daro which was post-Harappan Here only the sheep, pig and dog are represented, the sheep in very small quantities. The horse enters the scene.[517] We have already discussed its presence at the site.

Thus, at Mohenjo-daro we can see a clear evolution of the methods of animal husbandry beginning with the early introduction of cattle and pig in the economy. the addition of sheep ; buffalo, fowl in the mature period ; the dog may have been associated in the herding of cattle and sheep as well as guarding of crops and hunting ; and the dwindling of numbers and varities of animal species revealing a degeneration that had set in due to the natural calamities like excessive flood, gradual dessication. approaching aridity due to overgrazing etc. and the other attendent factors of the end of the Harappan civilization at Mohenjo-daro.

After this survey of the conditions of animals husbandry at Mohenjo-daro on the basis of the archaeological evidences recovered from the site, we shall like to approach the matter at hand from different angle. Currently. Walter. A. Fairservis, Jr.[518] has done a lot of hypothetical calculations regarding the human population at ancient Mohenjo-daro on the basis of several modern statistical figures. Although these calculations are entirely hypothetical and may not represent the exact picture, yet the method employed by Fairservis is extremely interesting and may be useful for further research on these lines. The Allchins have accepted the Mohenjo-daro population estimate made by Lambrick as well as Fairservis, which do not differ appreciably.[519] Moreover, this method of drawing inferences from recent statistical figures has gained more recognition, an example

being the work of Dr. Makkhan Lal on the ancient pattern of population growth in the Kanpur district.[520] Besides human population, Walter, A. Fairservis, Jr. has also drawn hypothetical conclusions regarding the number of cattle, amount of cereal cultivated, total acreage of land cultivated, the composition of the human population of Mohenjo-daro. He has based his conclusions on reports of surveyors and present day figures of crop-production, milk-production and utilisation, present day population estimates etc. Fairservis' thorough study can give us a guideline for further studies at other sites too. Because of its evident interest for us, we deem it proper here to go into a short discussion of his theories, calculations and conclusions.

Fairservis presents us a chart of 'Population Estimates For selected Sites in the Indo Iranian Borderlands, Based on Statistics of Modem Settlement in West Pakistan'. Here he has given the population of the Mohenjo-daro of Harappan times as 41,250.[521] This estimate is based on a comparison of house-plans at the excavated site and calculating a ratio of 800 sq. ft. per person, assuming that six persons occupied each house.[522]

This is the starting point of his calculations. Now, he points out, food scientists are of opinion that each individual requires a minimum of 2300 calories per day. Fairservis takes a mid-way estimate of 2500 calories per day per head.[523] Cereal grains necessarily constitute a quarter of the daily calory intake.[524] This comes to roughly between 1500 and 1600 calories. This amount of calory is provided by 477.6 grams of cereals.[525] So an individual requires 477.6 grams of cereal per day in his diet This come to roughly 174,214 grams per individual per year.[526] According to the reports of Revelle[527] and other writers,[528] the annual wheat yield per acre at Mohenjo-daro is 8.7 maunds in the present century. One maund is equal to 37,320 grams ; therefore 8.7 maunds is equal to 324,684 grams.[529] Therefore one acre of wheat-field around Mohenjo-daro would haved fed

(324,684÷174,214) = 1.86 individuals per year.[530] Since the population estimate for Mohenjo-daro is 41,250, there must have been a total wheat acerage of (41.250÷1.86) = 22,715 around the site, exclusive of the acerage necessary for other crops.[531]

Next, Fairservis proceeds to take into account the production of bajra and jowar and the fodder produced from these crops at Harappan Mohenjo-daro. Here, the situation is quite tricky. Fairservis, now takes up the cultivation of bajra and jowar at ancient Mohenjodaro on the basis of the figure for present dry-fodder acerage around the site. He, we can see, regards the cultivation of bajra and jowar as a matter of production of fodder only, which is very curious. He states first that the present day fodder acreage in the region is 12 percent of total acerage cultivated, or, at Mohenjodaro, 3097.5 acres.[532] So the total acreage of land under cultivation of wheat, jowar and bajra around ancient Mohenjo-daro amounted to (22,715 acres + 3097.5 acres) = 25,812.5 acres.[533]

From here, we pass on to further calculations provided by Fairservis to estimate the number of cattle working on these cultivated fields. He quotes Revelle's report to point out that at present a ratio of our bullock per eight cultivates acres is the average in the Khairpur state.[534] Now if one bullock could work eight acres, then (25,812 ÷ 8) = 3226.5 bullocks would be required to work the total of 25,812.5 acres.[535] Again, Fairservis points out that the ratio of work cows to work bullock is 0.2.[536] It comes to 2 cows per 10 bullocks. Hence, if at the ancient site of Mohenjo-daro there were 3226.5 work bullocks, there would be (3226.5 ÷10 × 2) = 645.3 cows correspondingly, working around the fields.[537]

So, we find that Faireservis has deduced a hypothetical number of working cattle around Mohenjo-daro.

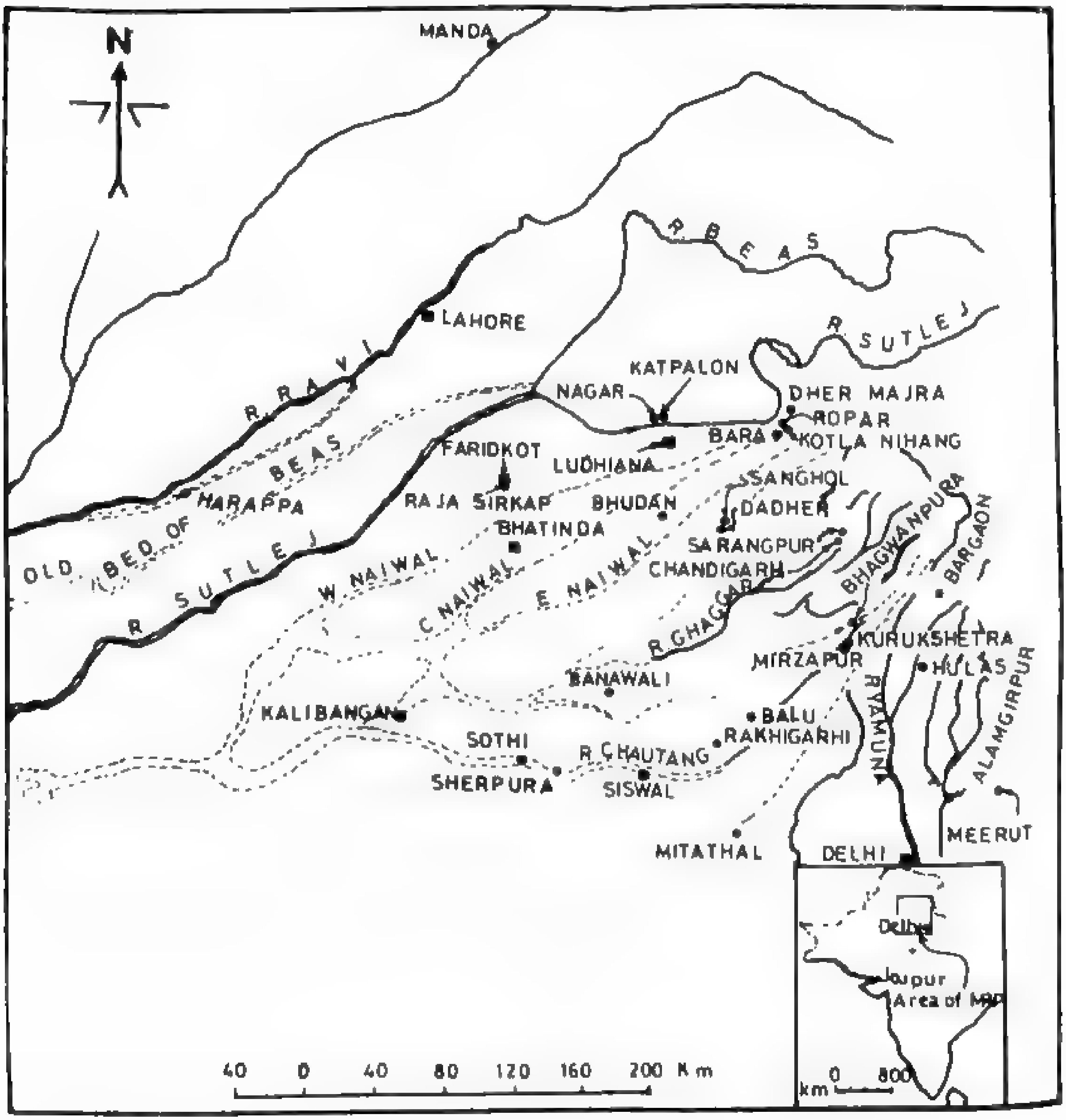
Now, as Faireservis correctly points out, domestic cattle

met two basic needs of the human sedentary population. First, they served as a source of food ; secondly, they also served as a source of energy. One of the principal work that the cattle was put to in a farming economy is the ploughing of the cultivation fields. We have already noted Fairservis' calculations regarding the number of cattle put to this work. Now, we shall pass on to the food-production part. Here, we find that Fairservis has again drawn some conclusions regarding the number of cattle based on the milk production figures of present-day.

Taking the average milk yield per milch cow as 9 pounds per day, Fairservis arrived at an approximate figure of 1,500,000 grams of milk yielded by one milch cow annually.[538] Now, Fairservis has noted that in West Pakistan of modern times sixty percent of the milk produced by cows goes to human consumption and forty percent to calves.[539] Sixty percent of 1,500,000 grams comes to 900,000.[540] Therefore, it may be assumed that 900,000 grams of cow-milk was available for the human population at ancient Mohenjo-daro from one milch cow annually.

Now, Fairservis proceeds to examine the matter from the point of view of human consumption. He gives a chart of the "Possible Individual Daily Diet in Ancient Times," in which he notes that an individual's daily requirement for dairy products amounts to 156.2 grams.[541] This comes to (156.2 × 365) = 57,013 grams per year per individual.[542] Fairservis rounds it off as 57,000 grams per year.[543] Now, if the requirement per individual annually amounts to 57,000 grams and 60% of the milk yield per cow annually is 900,000, then each milch cow provides for approximately (900,000 ÷ 57,000) = 15.8 people each year.[544] For a population of 41,250 people, therefore, the number of milch cow needed would be (41,250 ÷ 15.8) = 2610.7.[545] We have already noted that Fairservis has calculated the hypothetical number of working bullocks and working milch cows, also as 3226.5 and 645.3 respectively. The total

HARAPPANS IN NORTHINDIA



■ Modern Towns

Map of Harappans in North India

MAP- IV

number of working cattle comes to (3226.5 = 645.3) = 3871.8.[546] Fairservis substracts the number of working cows from the total number of milch cows assuming that they may also belong to the milch-group. So that the number of non-working milch-cows comes to (2,610.7-645.3) = 1965.4.[547]

Fairservis gives us a chart of the cattle population, viz.

Work Animal	
Bullocks	3226.5
Cows / Bullocks	645.3
Total	**3871.8**
Milk production cows	2610.7
Less cows already in hand	645.3
Total	1965.4
Milkless cows, calves and others (1/3 of total above)	2918.3
Total cattle	**8755.5**[548]

As we have seen above, Fairservis' theory and calculations present before us a picture of ancient Mohenjo-daro of the Harappan period as a settlement with a flourishing agricultural economy where animal husbandry occupied an important .position. There is no doubt about the fact that at the height of the Harappan period Mohenjo-daro had indeed enjoyed a very prosperous position having the agricultural and mineral resources at command and a flourishing trade and commerce. The city of Mohenjo-daro was inhabited by large numbers of artisans and administrative officials. The various artefacts at the site testify their presence. Now, in order to support these non-producing classes of people the farmers had to produce surplus crops. It would not be wrong to assume that if Fairservis' estimate for the population at Mohenjo-daro is correct, then the requirements for food crops as well as animal protein were also quite substantial. That these requirements were met adequately, at least during the mature period of the settlement,

is evident from the flourishing state of things at the urban site at that time. We can go on to presume that crop cultivation was difinitely done in the vicinity of the site. We shall examine the conditions for this when we study the agriculture practised at Mohenjo-daro. The implication hereby is that animal husbandry, especially that of cattle was also not as inadequate as Bhupendra Pal Singh would like us to believe. Sewell and Guha were also satisfied with the faunal evidence for cattle-herding at Mohenjodaro. Here we would like to quote them, -"The very considerable frequency with which the remains of *Bos indicus* have been met with during the excavations indicates that the inhabitants of Mohenjo-daro at one stage or another of their history maintained large herds of this animal."[549] This stage, it is most likely, corresponded with the early-mature stage, as indicated by the great development witnessed at the time. A thorough and complete excavation at Mohenjo-daro might clear some of the doubts regarding this matter.

From Mohenjo-daro we now turn to Harappa quite logically as the next prime city of the same cultural context. These two urban settlements best represent the Harappan urban cultural millieu.

Harappa, situated on the left bank of river Ravi in Western Punjab (Pakistan), enjoys an environment which ensured the growth of a herding economy. Here we find more substantial evidences for animal husbandry compared to those from Mohenjo-daro. The faunal remains at this site were examined by Baini Prasad, who reports the remains of almost thirty different species of animals, the total number of remains being much higher than those at Mohenjo-daro. Among these the number of domestic animal remains is much greater than those belonging to wild animals.[550] Unlike the evidence from Mohenjo-daro, here the remains of cattle are of a overwhelming majority among all faunal remains.[551] Bhupendra Pal Singh has put forward that cattle accounted for 57.9% of the total faunal assemblage and

75.7% of the basic food animals.[552]

Baini Prasad has clearly distinguished two types of cattle at the site, viz., one, a long-horned humped cattle of massive form ; the second, a smaller form with short-horns, which may represent a humpless variety.[553] We have already noticed that the artistic executions of bull from Mohenjo-daro also represent two types of cattle. Same kind of evidence comes from the seals and figurines of Harappa representing this animal.[554] We have already discussed the view of Baini Prasad as to the origins of these varities. Here we would like to point out that the upper molar teeth of the cattle specimen from Harappa resemble those from Mohenjo-daro and that their measurements are also similar.[555] It appears that the animal was quite commonly found in the region around the Sind and Punjab. If the osteological remains of cattle from the other sites in these and adjacent regions could be compared perhaps the distribution of a common variety of this species could be ascertained.

Baini Prasad has also stressed the antiquity of cattle domestication in this region.[556] In view of the recent faunal studies made at Mehrgarh we should appreciate his view more and mention it here that Prasad categorically states that it may have taken at least two to three thousand years to accomplish the domestication of the cattle from their wild ancestors.[557] Baini Prasad concluded as early as 1939, that the Indian cattle orginated in the Sind Valley and that the date of its domestication is contemporaneous with that of the European forms as suggested by Antonius.[558] The evidences from Mehrgarh and Balakot lend great support to his theory.

Next to cattle, in number, is the sheep (ovis vignei).[559] This is very interesting when we note that at Mohenjo-daro this animal was relatively scarce. We may note here that the nearby Punjab site of Jalilpur also yielded quite a number of sheep remains in the early Harappan or Kot-Dijian livels, as

we have already seen. It appears that in this region the sheep was the most favoured domestic animal next to the cattle. This indicates the pattern of animal husbandry practised and implies the primacy of food demands in the economy. Indeed, cattle and sheep provided profuse amount of milk and meat and the river plains afforded wonderful forage for them. Also, as we notice even at present, these two animals are mostly associated with an agricultural economy, especially cattle.

Prasad suggested that among all the other varieties of sheep, the Urial (ovis vignei), which according to Blanford[560] is found in the Punjab Salt Range and throughout the ranges west of the Indus in Pubjab and Sind down to the sea-level, roamed around Harappa and was perhaps domesticated by the Harappan people it all the sites.[561] R.H. Meadow, who studied the faunal remains at Mehrgarh, Balakot and Jalilpur, also favours the view that sheep, like the zebu cattle, was perhaps domesticated locally.[562]

Next to the sheep comes .the goat *(capra aegagrus)*. Although the number of fragments belonging to this animal is not very large at Harappa,[563] yet it is significant, considering its absence at Mohenjo-daro. Prasad pointed out that the horn-cores of the goat from Harappa generally resemble those of the recent domestic goat as also those of a goat figured by Duerst.[564]

Buffalo (Bos bubalus bubalis) appears in the faunal assemblages at Harappa almost as frequently as the goat.[565] We have already gone into the views of Prasad as to the origin and domestication of this species. Suffice it to mention here once more that he agrees with Rutimeyer[566] that the Indian buffalo is the ancestor of the domesticated buffaloes.[567] Prasad found that the remains of Harappan buffalo bore very close structural resemblance to those of the domestic buffalo kept in the Indian Museum. He, therefore, believes that the Harappan remains were of the same race

of domestic buffalo that is found in India at present.[568] A local domestication of the wild species of buffalo in the region is likely. The evidence at Harappa also indicates that the animal had already gained entry in the pattern of animal husbandry practised at the site.

Numerically the pig comes next to the buffalo. The remains of pig are very fragmentary. However, after a careful examination of the bones and teeth, Prasad unhesitatingly concludes that they belong to the domestic race of the Indian pig, Sus cristatus.[569] He also points that the bones mostly belong to the young of the species.[570] It appears clearly that the animal was domesticated by the Harappans for its meat and as the animal bred and increased in numbers quite rapidly, the people could afford an indiscriminate killing of the young pig for food. The Harappan evidence may be cited to support the theory that pig was also domesticated at Mohenjo-daro and for the same purpose. However, at Harappa, the importance of pig in the food economy was much less than at Mohenjo-daro, as is evident from the small number of its remains compared to those of cattle, sheep, goat and buffalo.

The last species at Harappa which was perhaps associated with food economy was the fowl *(Gallus gallus)*. However, the remains of this bird are extremely insignificant in number and hence, we may assume that it did not play any major role in animal husbandry.[571]

Passing on to the domestic animals not associated with food economy, we must mention the dog first. The remains of dog *(Canis familiaris)* are very scanty,[572] especially compared to those at Mohenjo-daro. However, Baini Prasad points out that the remains of the Harappan dog are comparatively very ancient and he also suggests that the animal must have been domesticated in the Indus Valley at a fairly early date.[573] Yet, as we have seen already, at Mohenjo-daro the animal appeared quite late on the scene, and then in slightly greater number.

Only three fragments belonging to the camel has been recovered from Harappa. After an examination of the specimens Baini Prasad came to be certain that they all resemble closely the *Camelus dromedarius*, the Indian one-humped cattle.[574] Prasad also concludes that the remains of the species at Harappa appears to indicate that this animal had already been domesticated.[575] The specimen of camel from the lower stratum of Mohenjo-daro together with the Harappan example seem to suggest that this animal had appeared on the scene at the region, albeit in small numbers, and was perhaps taken over for husbanding operations, especially as a beast of burden.

Here, we would like to refer to the view recently expressed by R. H. Meadow[576] as to the indentification of the species *camelus* at Mohenjo-daro,[577] Harappa[578] and Kalibangan.[579] He puts forward that the specimens of camel recovered from the above three sites were identified as *Camelus dromedarius* primarily on the basis of comparison with a single dromedary skeleton in the collections of the Zoological survey of India, and hence are not definitive evidence. He points out that, while qualitative osteological differences between bactarian or two-humped and dromedary, i.e., one humped camels can be found, these clearly were not sought when the Mohenjo-daro and Harappan materials were identified. So he suggests that one should ignore such specifications and accept that identification is possible only upto genus level (*Camelus* sp).[580]

A few remains of the Ass *(Equus asinus)* have been recovered at Harappa, which, according to Prasad, was imported to the Indus Valley from Africa via Arabia and Persia.[581] The presence of ass at Harappa, although few in number, perhaps indicates the animal's having been used by the people for carrying purposes. We do not find the ass at Mohenjo-daro, but we shall find that it was present in many of the ancient Harappan sites mainly east of the Indus Valley.

Recently Bhola Nath has examined the unworked collection from Mohenjo-daro kept at the Zoological Survey of India, and has come across the remains of a true horse (Equus Caballus, L.) among them. Nath pointed out, however, that the horse remains were obtained from the Area G at Harappa at the end of the Harappan Civilization, where, it has been suggested, an alien invading group of people overran and destroyed the city.[582] So, it would be wrong to associate the horse with the Harappan civilization proper. The same is true of the Mohenjo-daro specimen of *Equus Caballus*, as we have already noted.

The above survey of the faunal remains from Harappa reveal that compared to Mohenjo-daro, Harappa was enjoying a more flourishing state of husbandry, as is evident at least from its larger domestic animal resource and the mode of exploitation of these animals at the site. B. P. Singh provides us with graphic charts which indicate the pattern of exploitation of the faunal resources for food at Harappa.[583] We find that from the earliest levels (21 ft to 19 ft) at Harappa to about 12 ft below the surface, the number of total animal remains suggests less exploitation of faunal resources. In the upper 12 ft. there is great rise in the number of animal remains, indicating increasing exploitation of the fauna. The same pattern is evident in case of the domestic animals also, if we study them separately.[584]

Apart from this pattern of faunal exploitation, B. P. Singh also point out that the remains of young cattle are very few among the total cattle remains recovered at Harappa. he suggests that this imply a selective killing of the young of the stock and keeping the majority to attain maturity.[585] This points to the fact that the animal was used for other purposes than obtaining meat. Cow-milk was definitely a part of the diet. Besides, the animal was perhaps also used in the cultivation fields around the site. The beast was undoubtedly used for transportation of goods and men. From the large number of cattle bones it is evident that the

animal occupied the most important place in animal husbandry practised at Harappa.

B. P. Singh again points out that even in the case of sheep and goat the remains of Young of the species are apparently absent. He suggests that the reasons for this were the same as in the case of the cattle.[586] The sheep and goat were left to attain maturity for breeding stock, providing milk and wool, especially in case of the sheep. In case of the buffalo, Singh points out that the highly worn condition of the molars suggest that the animal was killed in an old age which implies that it was used for its milk and only killed when it stopped producing the same.[587] This beast could have also served as a means of transport. However, though the number of pigs at Harappa was small, most of the bones of that species belonged to young individuals.[588] This implies that the pig was kept solely for its meat.

The pattern of faunal exploitation at Harappa indicates that in the early days of the settlement animals were less exploited for food. At about the middle of the total period of occupation at the site, we note an increasing exploitation of the fauna, both domestic and wild. This heightened exploitation of animal resources remained constant until the late period of settlement at Harappa, when finally we notice a gradual decline in the incidence of cattle, sheep and goat. Between 8 ft. and 6 ft. below the surfaces the domestic fauna sharply declines. A further decline in the numbers of domestic animal remains is noted between 4 ft. and the surface. B. P. Singh puts forward that the decline of both domestic fauna, especially cattle, and the aquatic fauna, between 2 ft. below and the surface indicates the gradual abandonement of the settlement.[589]

The early evidence of less exploitation of the fauna at Harappa, B. P. singh suggests, imply a greater participation of cereals in the diet of the settlers.[590] We would like to point out here that this may also indicate a smaller population at the site in the early stages of occupation. When the site

gradually flourished and the settlement reached maturity, it also witnessed a rise in the human population which may account for the increasing exploitation of animals, both domestic, aquatic and wild, for food. Cereal definitely continued to constitute a major part of the diet even in the mature phase. The increasing or decreasing supply of cereal may have affected the exploitation pattern of animals at Harappa, but we have to keep in mind the factor of rise in population and the all-round development at Harappa, when we evaluate any evidence from the site. It would not do to hold that crop supply had in any way reduced in significance in the mature days at Harappa, in order to account for the increasing exploitation of fauna in these days. The above survey of the faunal remains from Harappa reveal that people at this settlement were witnessing a more flourishing stage of the technique, at least as is evident from its larger domestic animal resource than those at Mohenjodaro.

At Harappa we come across almost similar types of artistic evidences for animal domestication as at Mohenjodaro. Harappan seals and terracotta works abound in the depiction of a variety of domestic animals like the bull, ram, pig, goat, dog, cock and the buffalo. The bull was perhaps the most favourite animal for the Harappan artists. Quite a few terracotta figurines of this animal have been recovered from the site. A well-made terracotta bull with an exaggerated hump was found at Mound AB, stratum II. Roughly made humped bulls come from Area J, Mound AB, Mound F and so on.[591] Bull's heads were executed in faience and Sankh also.[592] One interesting example of a humped bull display a hole through the mouth to take a cord. Recovered from the Mound F at a depth of 7 ft 10 in. below the surface, stratum IIJ, this specimen may indicate a feature of domestication.[593] Several seals also depict the figure of the brahmani bull or Zebu.[594]

Several terracotta figurines of the dog with collars, and

in one case with a muzzle carrying something in the mouth has been recovered from Mound F, strata, IV, V, III and II.[595] Two terracotta reprosentations of the pig come from Mound F, Great Granary Area, Stratum III.[596] A realistic terracotta ram with indications of fleece as well as several faience rams were also encountered at the site.[597] A pedestalled head of a bearded and horned goat come from Mound F, stratum III, depth 7 ft. below surface.[598] we also come across a well-modelled terracotta cock with prominent crests from Mound F, Stratum II.[599] Lastly, we must mention that the Harappan seals also represent the figures of the bison[600] and the buffalo.[601]

Among the artifacts which are indirectly associated with the process of animal husbandry and utilisation of domestic animals at Harappa are the numerous terracotta wheels[602] and models of carts.[603] Vats has given a detailed description of a particular specimen of wheel recovered from Mound F, stratum V at Harappa. He relates that the wheel is slightly concave and is provided with vertical holes around the edge for attaching a super-structure. A pair of through holes are made in centre of each of the longer sides of the wheel for the axle and another hole is made in the front for the pole. Vats points out that this wheel is the only example of its sort so far recovered.[604]

Several types of toy-cart frames were salvaged from the trenches at Harappa. In fact the toy-carts from Harappa show a greater variety than those from Mohenjo-daro.[605] The most common type of cart of Harappa resemble the modern bullock-drawn vehicles of northern India, with an approximately square shape, low sidewalls and vertical projection at each corner for the rider to hold on to.[606] There can be little doubt that life-size versions of such carts indeed traversed the area around Harappa and were probably drawn by the domestic bulls and buffaloes. The cart-frames similar to those recovered at Mohenjo-daro were also fairly common at Harappa.[607] Besides these, a variety of other carts were also found at Harappa.[608]

A most interesting variety was the animal and bird chariots quite commonly found at this site.[609] Hollow figures of a bird or an animal were pierced with a transverse hole for wheels. A second hole in the neck or head is used to attach a cord by which the toy could be pulled along. A bull-chariot was recovered found in Area J at a depth of 14 ft. 9 in below the surface.[610] A cock-chariot comes from the Mound AB at the depth of 4 ft. below the surface.[611]

Lastly, the copper chariot from Harappa must be mentioned in detail. It is an extremely interesting piece of artistry and convey a good deal of evidence regarding the mode of land-transport in the Harappan milieu. This has been salvaged from Mound F. Stratum IV. Numerous fragments were pieced together to restore the extremely delicate miniature of a two-wheeled copper chariot. The chariot is open both at the front and back, with a gabled roof and side-walls. A human driver is seated in front on a raised seat. However, the animal supposed to be yoked to the chariot, the poles, the wheels and the axle are all missing.[612]

The above evidence strongly imply that the transport system of the Harappan times in this region was quite advanced. Naturally, a portion of the domestic animal population was put to this purpose. The most likely candidates were the bull and ox, and where available the ass and the buffalo. The urban Harappan culture flourished with the growth of a steady trade and commerce. Such activities could not be rendered possible without the domestic pack animals to circulate through the overland trading routes to distant regions. It is correct to assume that the technique of animal husbandry was sufficiently developed to provide the necessary animals on such occasions. At Harappa, therefore, the picture is quite complete by the contemporary standards. The economy of animal husbandry had acquired a stability by the Mature Harappan period.

Chanhu-daro, on the left plain of the Indus, about 130

Kilometres south Mohenjo-daro, is another major town-site of the Harappan culture.[613] Although the evidence is very scanty, yet here also we come across the remains of the *Bos* species, pig and goat *(capra hircus)*. Mackay, however, points out that it is not clear whether the cattle and the pig was domestic or wild at Chanhu-daro.[614] But, considering the evidences from nearby Mohenjo-daro, the practices of domesticating cattle and pig for purposes of diet etc. at Chanhu-daro is very probable. More interesting are perhaps the artistic evidences for domestication. As Mackay has pointed out, judging from the number of wheels and broken frames recovered from the site, toy-carts appear to have been extremely popular playthings. It will not be wrong to assume that real carts and also been quite a popular and familiar feature in everday life here.[615]

Mackay describes one particular type of toy cart-frame which resembled the life-size frames of carts well-adapted for carrying agricultural produce, such as straw, hay and the like. He points out that exactly similar little farm carts are in use in the modem Middle and Upper Sindh.[616] There were other types of cart-frames as well, one box-like in shape and a third 'even more like the modem carts of Sindh'. A fourth type of toy-cart or chariot frame had four wheels and a canopy-like arrangements in front.[617] These above mentioned toy-carts were made of terracotta.

But Chanhu-daro has yielded metal models of toy-carts as well. Two bronze models of carts have been recovered. In case of one, the figure of a man seated in front holding a stick in right hand is extremely significant for us. The sides of this car are covered by two bars, the wheels are solid and lacking in projecting hub.[618] It is very clear that this human driver was supposed to have been goading the pack animal with the stick to draw the vehicle. The other metal vehicle resembles in some respects the modem 'ekka'.[619] An almost similar model has been recovered from harappa. But the Harappan model sport the figure of a human driver. We have already described it above.

Besides these models of carts and chariots, we also come across instances of animal figures on wheels at Chanhu-daro. Three ram-chariots with hollow bodies, the heads added to the bodies by insertion of a long neck depicting tightly curled horns and having a hole through the neck to take a cord for pulling, have been recovered.[620] Besides these, a bull with a moveable head has also been recovered.[621] The above artistic evidences reinforce the somewhat limited faunal evidences and prove that the practice of animal husbandry was definitely flourishing here and proved excellent transport facilities. We have already noted the conditions of animal husbandry in a pre-Harappan context at the site of Balakot in the south-eastern corner of the Las Bela Plain, about sixteen Kilometers inland from the Arabian Sea.[622] We have seen that among the total faunal assemblage at this level of Balakot, cattle had overwhelmingly dominated over other species in number, making up about seventy-five percent of the mammalian remains. Sheep and goat followed next. But the Harappan levels at the site yielded evidences indicating a somewhat different situation. It is found that at this level the small mammals, viz., goat and sheep, make up about sixty percent of the faunal assemblage,[623] while the large mammals, consisting primarily of cattle, made up the rest of the forty percent. Besides, some new species also make their appearance. The water buffalo was added to the domestic stock. The nilgai was added to gazelle as an animal hunted for meat. Also from this level, comes the evidence for the use of aquatic fauna in the diet of the settlers. The mollusks were represented in large numbers. Fish also had clearly become an important part of their diet. This is very interesting for, as we have seen earlier, fish bones were completely absent from the pre-Harappan levels. Shells were also rare in that level.[624]

Meadow has correctly pointed out that the overwhelming number of cattle remains in the pre-Harappan context at Balakot suggest a nearly complete dependence of the population on that animal.[625] However, the evidences indicate

that in the Harappan period the people at Balakot were herding sheep and goat in large numbers so that the remains of these small mammals constituted more than half of the total faunal remains. The Harappans at Balakot had therefore shifted from a primarily cattle dominated farming to a mixed farming where small ruminants might have proved to be profitable. Meadow has suggested that while the pre-Harappan Balakotians grazed their cattle-dominated herds in the alluvial areas immediately around the site, the Harappan settlers reached out to more distant areas grazing their numerous sheep and goats in the marginal areas on the terraces and uplands surrounding the site.[626]

The Khurkhera Plain where Balakot is situated is at present covered with scanty vegetation of sub-tropical nature. This present condition may be more dus to the result of over-grazing by cattle and cutting of even these shrubs for fuel. But this region also receives low rainfall. So that the region was never very lush and green. However, the windar river that runs through the plain floods every monsoon and deposits heavy sediment over the plain, so that the alluvial tracts must have supported a luxurious growth.[627] The domestic herds maintained by the pre-Harappan and Harappan Balakotians thrived mainly on this. But the sheep and goat could be taken some distance from the settlement and grazed on the terraces where these animals found the fodder they preferred. Cattle was restricted more to the alluvial tracts on the plain.

There was also a notable difference between the pattern of exploitation of Cattle at Balakot in the pre-Harappan or Balakotian level and the Harappan level. Meadow has pointed out that in the former context a high calf mortality could be noted with only seventy-two percent of the animals surviving the first eighteen months. In the Harappan period ninety percent of the calves survived this period of one and a half years. The Harappans apparently waited for their

cattle to grow before killing. It was allowed to survive upto three of three and a half years on an average.[628]

According to Meadow, this indicates that at Balakot the Harappans were already attempting an optimisation of meat production and also practising a selective breeding in order to propagate the herd.[629] Moreover, the pattern of faunal exploitation had also changed, for while the pre-Harappan or Balakotian folks were relying primarily on cattle for animal protein their Harappan successors at the site were more keen on a mixed farming economy and supplements it with fishing.

At Balakot, therefore, the sophisticated practice of stock breeding and selective slaughtering of grown up animals had already begun as at Harappa. But we have already seen that at Mohenjo-daro this practice had not developed quite so efficiently as at Harappa even in the mature Harappan phase. It may resonably be assumed, that while in and around the settlements at Harappa and Balakot, animal husbandry had reached a certain standard where the herders had begun to view their profession from a more economic angle and were learning to derive the optimum advantages from a balanced practice of husbandry, at Mohenjo-daro, the situation was not so developed.

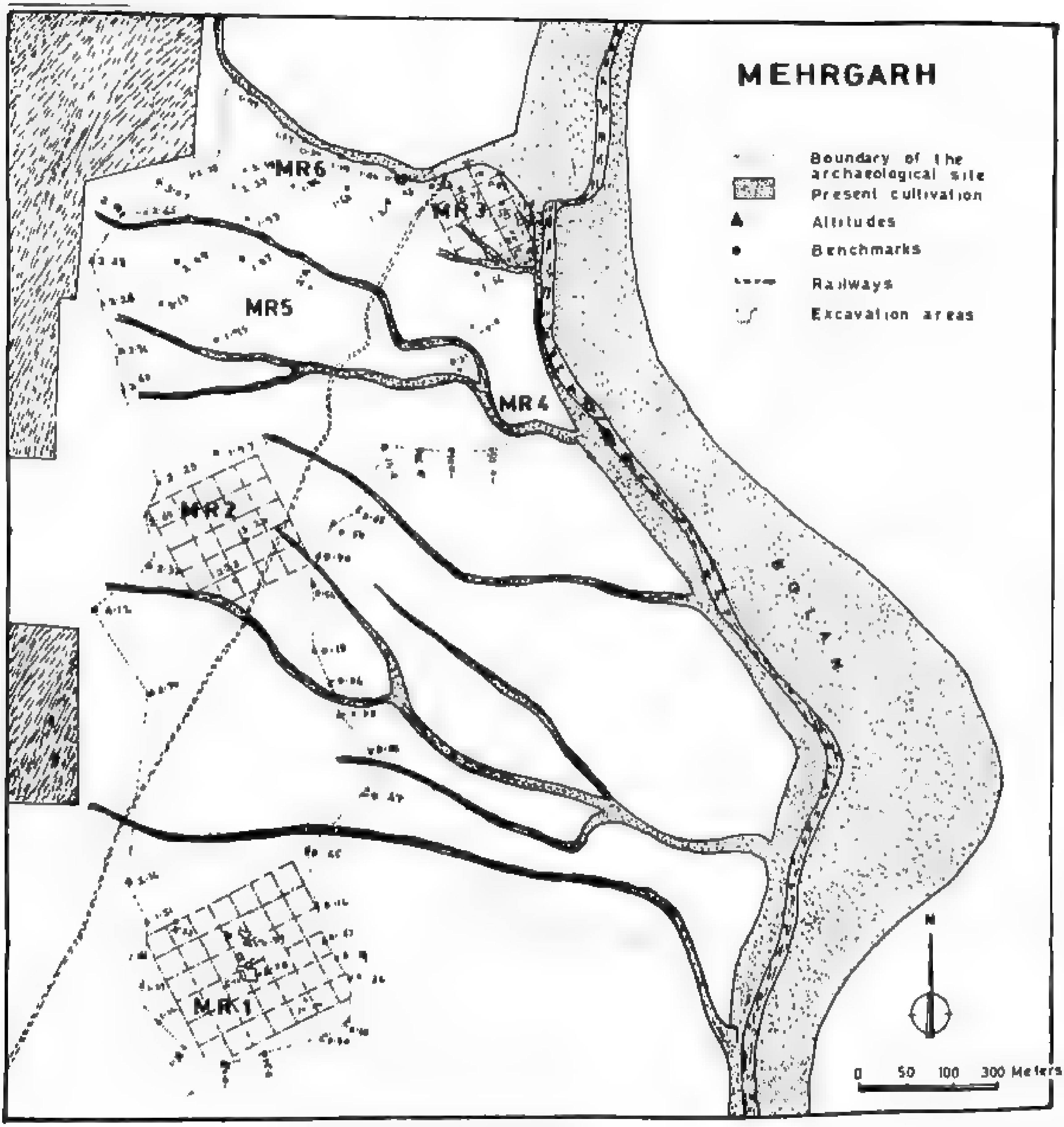
Lastly, we must mention the other associated artifacts indicating the popularity of the practice of animal husbandry at Balakot. We find a large number of terracotta humped bull figurines, a few figurines of rams, elephants and birds, cart wheels, and six bulls painted in the kulli style.[630] The period II occupation at Balakot has been dated by G. F. Dales around C 2100 - C 200- B.C.[631]

Such systamatic study of the faunal evidences as conducted at Balakot have not been carried out at any other small village site of the Harappan context. Therefore, we have to mainly depend on assumptions based on the findings at Balakot alone, regarding the role of the villages in the

development of the processes of animal husbandry in the Mature Harappan phase.

As we have seen the faunal evidences at Balakot indicate that animal husbandry had been a major economy. Balakot was a small village site, perhaps primarily inhabited by a farming people, where farming and herding had formed the chief economic occupations. Here a group of specialised herdsmen may have been in charge of the economy of animal husbandry. Steadily the expertise of these herdsmen developed and the techniques of animal husbandry, under pressure of a growing population not only in the immediate village surroundings but also in the outlying regions, had developed and matured steadily. These were the times when mere subsistence economy was not enough. Export and import of food-crops and even animal protein must have developed between the different town settlements and between towns and villages. The food from the villages must have sustained the non-producers in the cities. Villages like Balakot had to make the optimum use of the natural resources at their hands. Hence, the practice of animal husbandry, as we have already noted above, received a great deal of attention and care and the modes of selective killing and breeding of animals as well as mixed stock farming developed. It may have been that at the small village sites like the one at Balakot, throughout the regions of Sind and Punjab, the practice of animal husbandry reached a mature level more quickly than at major city-centres like Mohenjo-daro, where multiple activities marked the everyday life. Harappa, however, proves that this was not always so.

At about the same time as the Mature Harappan culture flourished in the Sind and the Punjab, Kalibangan, in Ganganagar District, Rajasthan underwent the same experience of this new cultural growth (C 2500 B. C. MASCA corrected dating).[632] We have already seen that the pre-Harappan settlement at Kalibangan had grown to



Map of the site of Mehrgarh

MAP - V

semitownship proportions. The Harappan settlement, although not immediately following the pre-Harappan occupation, was built on an even larger scale. Like the metropolises of Harappa and Mohenjo-daro, the settlement at Kalibangan also had two distinct mounds, representing a 'Citadel' and a 'Lower Town'. The township was built in the typical gridiron Indus pattern. The wells, bathing pavements and drains were built of Kiln-burnt bricks. the typical Harappan pottery, weights, measures, seals and sealings ; the terracotta toy-cart frames, wheels, rattles, birds, animals and gamesman ; copper tools and weapons — comprise the artifacts associated with the typical Harappan metropolitan life at Kalibangan.[633]

However, it is unfortunate that the reports on the excavations at Harappan Kalibangan do not provide a scientific and analytic study of the faunal remains. In the absence of fuller facts, we have to make do with the meagre information we have at hand and add to this the incidental evidences for animal husbandry as well as study the ecological setting of the site in order to draw hypothetical picture of the conditions of animal husbandry here.

The domestic refuse at the site provided a good sampling of animal bones. The preliminary studies of these bones indicate the existence of the Indian domestic humped cattle or zebu, Indian buffalo, pig, goat, sheep, humped camel, domestic ass, and among the wild species, the barasingha, elephant, rhinoceros, chital and fowl.[634] About fowl, it cannot be definitely said whether it was domesticated or not.

The report on the faunal assemblage at Kalibangan in the Indian Archaeology - 1964-65 - A Review, states that among the total faunal remains, the bones of the humped cattle formed the largest percentage.[635] This has been the same at Harappa and to some extent at Mohenjo-daro. Indeed, cattle already appears to have dominated the scene

of animal husbandry from earlier times and by these mature Harappan days its potential as a domestic animal in everyday life had been fully realised and sought to be tapped. Goat and sheep were a common feature from even earlier times. The pig, as we have seen at Mohenjo-daro had also begun to be favoured by the urban dwellers. The report also points out that the occurrance of the bones of the camel is significant. We have come across skeletal remains of a camel at Mohenjo-daro as well as at Harappa. It seems that this beast of the deserts had reached the sands of Rajasthan around the middle of the third millennium B. C. Where it is still a common sight. It also seems probable that camel along with ass and cattle has served as beasts of burden and promoted transport in the region. The presence of the Indian buffalo is also very interesting. so far this animal has been reported from only a very few sites, among which are Mohenjo-daro and Harappa. It should be mentioned here that A. K. Sharma informs us of the discovery of the remains of trun horse from Kalibangan by V. V. Rao.[636] But in view of the total evidence for animal husbandry in the Harappan context and in the present state of our knowledge regarding the coming of horse in India, it is doubtful whether this discovery can be attached much significance.

Now, considering the geographical setting of the site, where, evidence suggest, farming had been quite a major occupation, the facilities for developing a farming and herding economy were ample. The location of the site on an ancient bed of the Ghaggar which must have carried substantial water around the third millennium B.C., ensured enough riverine grazing ground for domestic herds of cattle. In these surroundings it was quite natural for a large herd of cattle to be maintained for economic reasons. But, if the setting was ideal for cattle, it was no less advantageous for the maintenance of other domestic species as the varied taxa of the faunal remains at Kalibangan indicate. The variety of the domestic animals maintained at the site not

only signify a favourable ecology but also point to the awareness and the needs of the local people. The animals seemed to have served the twin purposes of food and draught.

The location of Kalibangan at a strategic point in the Indo-Gangetic Divide, must have given impetus to its growth as a major metropolis of the Mautre Harappan days. The river system not only provided the setting for farming, but also provided for links with other regions and helped in trade and commerce. How far animal husbandry helped in the development of overland trade can only be surmised. But the prosperous conditions of the urban life hint at a flourishing economy and a busy commerce. We have already noted the recovery of model terracotta cart-wheels from the pre-Harappan levels at this site. Thus it seems that the use of wheeled vehicles was in vogue quite early. The terracotta toycart frames and wheels at the Harappan levels[637] Indicate the popular use of the cart as a vehicle in every-day life, drawn by the domestic draught animals. A caravan of such carts was most probably used for trade and communication throughout the regions of Baluchistan, Sind, Punjab, and Rajasthan and other adjacent regions as well. Some terracotta figurines of bull have also been recovered from this period.[638] A very exquisitely modelled figurine of bull in copper is note-worthy for its expression.[639]

A most interesting development was taking place by this time, i.e., the influx of the Mature Harappan culture into Saurashtra and Kutch in Gujarat. It is significant that these regions, east of the Indus region and south of the Ghaggar-Hakra-Saraswati complex, had so far not been within the mainstream of cultural growth and fell outside the Early Harappan cultural fromtiers. Only at surkotada traces of an indigenous element has been noted which was somewhat common with the pre-Harappan Kalibangan and Kot Diji Culture.[640]

The Mature Harappan Phase saw the rise of several sites in saurashtra and a few in Kutch.[641] As Y.M. Chitalwala points out. the Sind and Saurashtra, to some extent, form an ecologically contiguous unit, although there are certain differences also.[642] Ecologically Kutch and Saurashtra are both semi-arid regions. Saurashtra is characterised by the Deccan lava black soil. The rivers radiate in all directions and provide rich soil and water. Rainfall, however, is patchy and scattered. Kutch receives a very low rainfall which helps to grow only grass to feed the cattle.[643] The view that a migration took plaçe from the Sind to Saurashtra about the Mature Harappan phase is generally accepted.[644] Kutch is also connected with Sind by land-route and the probability of ancient communications by the sea-route in also high.[645]

In Kathiawar, the Harappans mainly settled down in the vicinity of the rivers like Bhadar, Kalubhar and Ghelo. In the Kutch they settled in the fertile coastal strip as well as the central region of Bhuj, also fairly fertile.[646] The Harappans thus appear to have chosen suitable ecological niches where adequate resources were available for agriculture and animal husbandry. From the recovery of large number of bones of cattle, sheep and goat from most of the Gujarat sites, it appears that these animals were commonly herded in the Mature Harappan period.

Speaking specifically about the Rajkot District of Saurashtra, Y.M. Chitalwala points out that the recovery of large number of cattle bones as surface collection indicated that cattle farming was an "important integral component of Harappan and post-Harappan economy."[647] Buffaloes were also domesticated in Harappan Saurashtra as in Sind. Chitalwala also points out that it is possible as M.K. Dhavalikar and G.L. Possehl postulates for the early farming communities of western India, that the Harappan and post-Harappan farmers grew fodder on separate pieces of land.[648] How far this assumption can be accepted is a matter of much doubt, for as, we have already seen, fertile land was

very limited in Kutch and slightly less so in Saurashtra. In the circumstances crops for human consumption must have been the preference of the cultivators, especially since the dried straw of rice, bajra and wheat could serve as fodder very well.

Now, we shall pass on to some particular evidences from certain sites in Gujarat. Lothal in Ahmedabad District in Saurashtra is the most important site which sprang up into one of the major Harappan cities east of the Indus almost on the scales of Mohenjodaro and Harappa. The site is situated on a low-lying ground sandwitched between the Bhogavo and Sabarmati rivers.[649] The Mature Harappan Culture lasted at Lothal from the phase II of period A to the phase III of the same period, and ended in phase IV of the period A[650] covering the time from C 2200 - 2100 B.C. to C 1800 - 1700 B.C.[651] The lay-out of the settlement is slightly at variance with that of Harappa and Mohenjo-daro. But as usual, there were two divisions of the city-the 'Acropolis' and the 'Lower town'.[652] The 'basin'[653] or 'dock'[654] at Lothal has aroused a lot of interest and controversial theories among the scholars. The exact nature of the use of this structure has not yet been unanimously decided. But one thing is clear that this town played an important part as a Harappan trading station and that trading by sea-route was a possibility.[655]

At Lothal we observe the presence of twenty-three different animal species in the faunal assemblage, the majority of the remains belonging to the Bos indicus. The other domestic animals represented by bones are the buffalo, goat, sheep and pig. These animals are similar in structure and size to these that were present at Harappa and Mohenjo-daro of old. The dog, canis familiaris is present from the earliest times of the Harappan civilization at Lothal. The fowl was also present and was akin to the Harappan fowl. Extremely interesting is the recovery of the remains of the true horse, Equus Caballus L from the Late Harappan levels

at Lothal.[656] We shall take up this subject in details at the end of this context. Terracotta models and seal engravings of the bull or cow are very common. Terracotta toy-cart wheels and frames were also recovered.[657] Interesting is the presence of a copper figurine of dog.[658]

Surkotada in District Kutch is another important Harappan settlement with the typical town planning, a citadel in the west and an adjoining residential area in the east.[659] The region is one of scanty vegetation, mainly consisting of cactus, small babul and pilu trees. Ground survey and morphological examination of the features of the area reveal that in ancient days a quarter kilometer wide river flowed past the north-eastern side of the ancient mound and emptied itself further down into the little Rann of Kutch. This river has now been reduced to a nullah.[670] The Harappan occupation at the site has been divided into three sub periods, viz., period IA, IB and IC. J.P. Joshi has dated these periods between C 2100 B.C. and C 1750 B.C.[671] He also suggests that perhaps surkotada was a defensive complex which was built to afford protection to the east-ward movement ot the Harappans or it might have been a well-protected trading centre.[672] Surkotada has yielded evidences for the existence of true horse from the earliest level of occupation. Sufficient number of bones of Equus Caballus have been identified. Apart from these, bones of Equus asinus Linn (ass) and Equus hemionus Khur (hemione) have also been recovered. The bones of the horse occur from period IA to IC. The presence of a few charred pieces is very interesting.[673] A.K. Sharma asserts that the above evidence shows that the Harappans at Surkotada were acquainted with the animal and that associated with the horse were the ass and hemione.[674] In fact the hemione is still found in large numbers in the Little Rann of Kutch. However, we have not yet any definite report as to whether the horse was used for transport. A.K. Sharma points out that a detailed study of the horse-bones from the site may

throw light on this question.[675] Putting together the evidences of horse remains from Lothal at the late period of Harappan culture and the presence of horse bones from period IA onwards at Surkotada, we may assume, that the animal was perhaps known to the Harappans in Gujarat at a late date. However, it cannot be said that horse had become a common animal around these parts at this time. Barring, these two somewhat isolated instances, no other site in Gujarat has reported the remains of this animal.

A number of medium-sized settlements have also been unearthed in Gujarat which were smaller and less significant than the urban sites like Lothal and Surkotada. Rangpur, the most prominent among such sites, was contemporaneous with the middle and late phases of the Lothal period A.[676] Located in the Limbdi Taluka of District Surendranagar in Gujarat, the site is situated on the bank of the river Bhadar. An ancient flow-channel of the river is still traceable on the western side of the mound.[677] Bhola Nath who examined the faunal remains at Rangpur reports the presence of five domestic species from the Mature Harappan (period IIA), viz.; Bos indicus or Indian bull/cow, Bos (Bubalus) bubalis or buffalo, ovis vignei or sheep, capra hircus or goat and Sus scrofe cristatus or pig.[678] These animals in general resemble in their species those of Harappa and Mohenjo-daro.[679] The bones at Rangpur are mostly fragmentary. In many cases charred bones have been found as at Harappa and Mohenjo-daro. Bhola Nath particularly mentions nine fragments of bones which bear definite marks of having been chopped by sharp instruments. Seven of these bones belong to Bos indicus, one to Bos (bubalus) bubalis and one to Sus scrofa cristatus. This clearly indicates that the inhabitants fed on the flesh of these animals.[680] Bhola Nath also points out that a large number of bones belong to young animals as in the case of Anau, Mohenjo-daro and Harappa and is a feature associated with the practice of domestication of these animals.[681]

Of the total faunal remains at Rangpur, those belonging to the cattle alone comprised seventy eight percent, the bones of sheep and goat together constitute eleven percent of the total assemblage and those of pig eight percent, while remains of the buffalo make up two percent and the rest one percent.[682] The remains of the humped cattle from Rangpur resemble the smaller humped short horned variety from Harappa, Mohenjo-daro and Maski. The remains also closely resemble the present day domestic cattle in India.[683] It is interesting to note that the domestic dog (*Canis familiaris*) and the domestic ass (*Equus asinus*) arrive on the scene at Rangpur in the Late period of the Lustrous Red Ware culture (period III).[684] Though the remains of these animals were extremely rare, yet their absence in the Harappan period and appearance in period III signifies a late migration of the domestic dog and ass in Gujarat. Apparently, the Harappans in Gujarat had never engaged in hunting with the dog as their assistant. The limited number of wild species' remains at Lothal[685] and their complete absence at Rangpur period IIA-IIB[686] also indicate the insignificance of hunting. This may be taken as a sign of a full-dependence on the practice of herding as an economy for the supply animal protein in diet for there could have been no lack of wild game in the ecological context of Saurashtra. It is also evident that the economy of animal husbandry operated quite successfully and met the needs of the ever-increasing population in the region.

The evidence of small village settlements in Gujarat would further serve to emphasis this aspect of the economic situation. Here we should note that the cattle was the animal that carried the full burden of the high demends of such a society. Explorations in Gujarat have revealed the existence of numerous small village-settlements of the Harappan cultural context especially in Kathiawar, from prominent ones like Rojdi, Adko and Akru to small ones in the interior like Babarkot, Pansina and so on and others

near Lothal like Kanjetar, Koth etc.[687] Here we would like to concentrate on some interesting evidences from the Kheda district in Gujarat, where recent explorations have brought to light the existence of a number of small Harappan settlements.[688] Among these the sites like Kanewal, Nor and Vadgam are more prominent.[689] At all these sites excavations and surface collections enabled the recovery of remains of animals such as the cow, buffalo, goat and sheep.[690] K. N. Momin states that they were probably domesticated and belonged to cattle breeders or mixed farmers.[691]

The excavation at Kanewal especially yielded interesting informations. The inhabitants of Kanewal lived in circular huts with earthen floors and wooden posts and walls of wattle and daub. They used jars, dishes, bowls, dishes on stand in four types of ceramics, viz., Red Ware, Buff Ware, Lustrous Red Ware and crude incised Ware. Terracotta triangular and round cakes, balls, spindle whorls, beads of carnelian, faience, shell and terracotta ; stone querns, mullers, and rubber stones ; a copper bangle and strips of copper ; terracotta figurines of bulls and birds as well as toy-cart wheels are the other miscellaneous objects associated with the Harappan occupations here. Long split bones of cattle, buffalo, goat, sheep, deer, chital, barasingha, nilgai indicate the animal protein intake in the diet of the inhabitants.[692] Of these the first four species were evidently domesticate as the evidence from other sites also indicate. Curiously enough, Momin reports the presence of bones of horse and camel also from the habitational deposits of this site.[693] The horse most probably came in the late stage of occupation and was perhaps associated with the Lustrous Red Ware culture.

The fertile black cotton soil in Gujarat attracted the Harappan farmers. Explorations have also revealed interesting evidences for the existence of temporary camps or stations of Harappan cattle-breeders. R. N. Mehta reports the presence of such sites in Nesadi in Bhavnagar District

in the taluk of Valabhi.[694] One such site revealed, on excavation, the signs of a circular structure, presence of Red Ware, Buff Ware, Black-and-Red Ware, Crude Red Ware, perforated jars and other ceramics and terracotta bull figurines. The faunal remains indicated the presence of cows and deer. The sites at Nesadi are flooded in monsoon but remains dry in winter and summer which rules out the possibility of permanent settlements. The structures probably indicate temporary habitations.[695] The existence of cattle bones, ceramics and terracotta bull figurines may point out to the possibility of a case of temporary camps of migratory cattle-breeders here.[696] This kind of temporary migrations still occurs in this area. In this migration the cow herds return each time to the area where they have come before and thus the area is repeatedly occupied. R. N. Mehta points out that this feature would account for the presence of different ceramic components at the same site, and also explain the different places of occupation at the Nesadi locality as also the sparse settlement where at any given time only a few cow-herd families might have lived.[697]

The evidence from Nesadi remind us somewhat of the South Indian neolithic habitations at Utnur etc., which, as Allchin has suggested, also represent temporary camps of cattle-breeders. However, in Gujarat there is no evidence of stockades having been built to keep the animals. R. N. Mehta has also suggested that many of the tiny sites located in the Ghaggar valley of the Bahawalpur region may also belong to this category of settlements.[698]

The Mature Harappan culture spread over to the eastern Punjab, Haryana and even as far cast as Western Uttar Pradesh in the plains of the Sutlej, Saraswati, Drishadvati and Yamuna. Rupar in District Ambala, on the Sutlej was one such site in eastern Punjab which was occupied first by the Harappan. The settlement was characterised by the Harappan pottery, beeds, bronze celts, chert blades, terracotta cakes and an inscribed steatite seal.[699] The faunal assem-

blages reveal the presence of cattle, buffalo, goat, sheep and pig with a few cut marks on the bones, indicating that the meat of these animals was included in the diet of the settlers.[700]

At Banawali in Haryana the Mature Harappan culture emerged around C 2300 B.C.[701] All the typical features of the culture were present, viz., Harappan ceramics, seals, script, weights, clay figurines, copper tools etc.[702] The terracotta figurines of bull, buffalo, ram, dog, deer, rhinoceros, tiger and bird have been recovered.[703] The bull figurines far out number all others. A few animal figurines were fitted with wheels.[704] It appears from the plates provided by Bisht that some of these wheeled figurines represent the horned bull.[705] Toy cart-frames, including a few solid clay platforms, are abundant.[706] The sites of Mitathal and Rakhigarhi also experienced the upsurge of the Mature Harappan culture. However, no definite evidence is available on which we can draw inferences regarding the economy of animal husbandry at these sites. Alamgirpur, 17 miles west of Meerut, on the left bank of the river Hindon,[707] a tributary of the Yamuna, was probably a small Harappan outpost towards the end of the Mature Harappan period. The typical Harappan pottery, Kiln-burnt bricks, terracotta cakes, a few objects of copper, terracotta ornaments etc.,[708] comprise the cultural assemblages. Of interest to us are the terracotta cart-frames and fragmentary body of a terracotta humped bull.[709]

The evidences for animal husbandry in these peripheral regions are meagre. But, we cannot doubt the fact that the techniques of animal husbandry had been adpoted in these region on a full scale, to meet the requirements of the cultural developments that were taking place. At Rupar, especially we find evidence for a regular mixed stock herding for distary requirements. The presence of terracotta bulls and toy cart frames of wheels and the figurines of bulls fitted with wheels at these sites surely indicate the regular use of

ox-drawn wheeled carts in the busy every day life of these settlements. It is evident that in those days of hectic cultural contacts over a wide region from the Indus valley to the western Uttar Pradesh and from Gujarat to the Gandhara region, the overland communication was extremely facilitated by these vehicles. Indeed the domestic animals were not only producing animal protein for the human diet but also supporting the growth of trade, commerce and cultural communications.

The Mature Harappans were practising a vigorous economy comprising animal husbandry and agriculture which lay at the base of all their affluence and sophistication. Our study above shows that they had acquired a great deal of skill in their handling of the techniques of animal husbandry. They possessed a mixed-stock herding economy and, not only that, they were already making the optimum use of their domestic animals. They employed these animals not only in food production but also in the spheres of transport and were probably utilishing some beasts like the cattle in agricultural operations even. The cattle also served as excellent beasts of burden in the absence of the horse and perhaps caravans of cattle carried out overland trading operation in the Mature Harappan days. In this field the cattle was also joined by the asses and hemiones and sometimes the camel. As Mackay points out, the corners of the smaller by-ways at Mohenjodaro, especially, show evidence of having been rubbed by pack animals or the clothing of passers-by. He also points out that in some cases the angles of a building were purposely rounded-off so that pack-loads should not become dislodged, a device which has also been observed in ancient Ur, he mentions. Mackay assumes that 'the humble donkey' may have been used in the narrow as well wider streets.[710]

The cattle was perhaps the most inportant domestic animal in their economy. This was perhaps reflected in the numerous artistic depictions of this animal by the Mature

Harappan artists. In fact W.A. Fairservis has pointed out this emphasis on representation of cattle on seals and figurines as one of the major cultural traits or features of the Mature Harappan civilization.[711] W.A. Fairservis[712] and the Allchins[713] are of opinion that these depictions of the cattle had some religious significance.

The Allchins point out that the application of a sacrosanct character to the cattle may be traced to the pre-Harappan days.They cite the examples of the painted designs on the pre-Harappan pottery which often represent a horned head, sometimes with pipal leaves rising between the horns. The Allchins point out that the horns seem to be those of buffaloes. Hence they designate these as representaions of a buffalo deity.[714] However, sometimes, for example in case of a specimen from the site of Lewan, the horns seem to have belonged to the *Bos indicus* and the Allchins call it, by extension, the Bull deity. They point out that thus there were already certain associations of buffaloes and bulls/cows with a horned deity or deities in the pre-Harappan context which anticipate the horned deity of the Mature Indus religion. These representations have come from the pre-Harappan sites of Gumla, Rahman Dheri, Lewan, Sarai Khola and Kot Dije.[715]

In the Mature Harappan context the instance of the horned deity are depicted on a series of Mature Harappan seals which represent a human figure seated in a Yogic posture which is designated as *Paśupati* (or Siva) on account of its being surrounded by jungle animals. This figure wears a great buffalo-horned head-dress with pipal leaves sprouting between the horns. Another group of human figures on seals and amulets also have horns on the head and long tails. They sometimes also have hind legs and hoofs of cattle.[716] Against the back-ground of these evidences, the Allchins are of opinion that the bull, cow and buffalo may be expected to have had a special role in the religion of the Mature Harappans.[717]

We must seek the reason behind this application of religions significance on cattle. We must remember that bull figurines also had become a common find at most Harappan sites. Are these simply representations of the religions beliefs of the Harappans? Do they not have deeper socio-economic significance? In view, of our assessment of the state of animal husbandry in the Mature Harappan economy and the role that cattle played in this, we can not fail to conclude that this animal had become a very important domestic beast to the farming Harappans. It is natural in the circumstances that the awareness of this importance of the beast may get reflected in the religions beliefs of the simple Harappan folks. Cattle may have represented food and bounties to the people and may have been worshipped for these reasons. We shall see a similar association of awareness of economic values and religious beliefs regarding the cattle in the vedic context later on. Thus, as Fairservis points out, in the bull represented on the seals we are dealing with an animal that not only must have been a principal factor of the religious scheme of the Harappans, but a significant entity in the economy — 'perhaps the *raison d'etre* for its sacrosanct character'.[718] What we have noted above leads us to the conculsion that by the Mature Harappan days the economy of animal husbandry had been organised to a great extent to serve the purposes of the greater economy and the society in the Harappan milieu.

Before we pass on to the Harappan context we must take up the question of the presence of the horse in the Mature Harappan context. It is commonly accepted that the horse (*Equus Caballus* Linn) had been introduced to the Indian sub-continent around the middle of the second millennium B.C. with the influx of the Aryans. But, a few reports of the discovery of the remains of this animal in the Harappan context raises the issue of the introduction of horse that has to be dealt with here. As we have noted above, there are sporadic occurrences of horse remains

referred to in reports from a few Harappan sites. Even from the pre-Harappan site of Rana Ghundai such evidence has been obtained in the from of equine teeth. But this evidence, as we have seen, has been challenged by F. E. Zeuner who suggests that they may have belonged to the hemione.[719] Now, in view of the report of the animal's presence at a number of Harappan sites, Harappa and Mohenjo-daro included, we would like to go into some details regarding this problem of the appearance of horse early in our subcontinent which would lead one to consider the matter of the early history of the horse in our sub-continent from a new angle. The question here is that whether it is correct to associate the coming of the horse with the coming of the Aryans to this region ; or whether to conclude that a few stray horses had crept across the border into the Indian sub-continent as a wild beast before the advent of the Aryans, but that the animal was fully domesticated, trained and familiarised by the Aryans who brought herds of this animal when they came this way to stay.

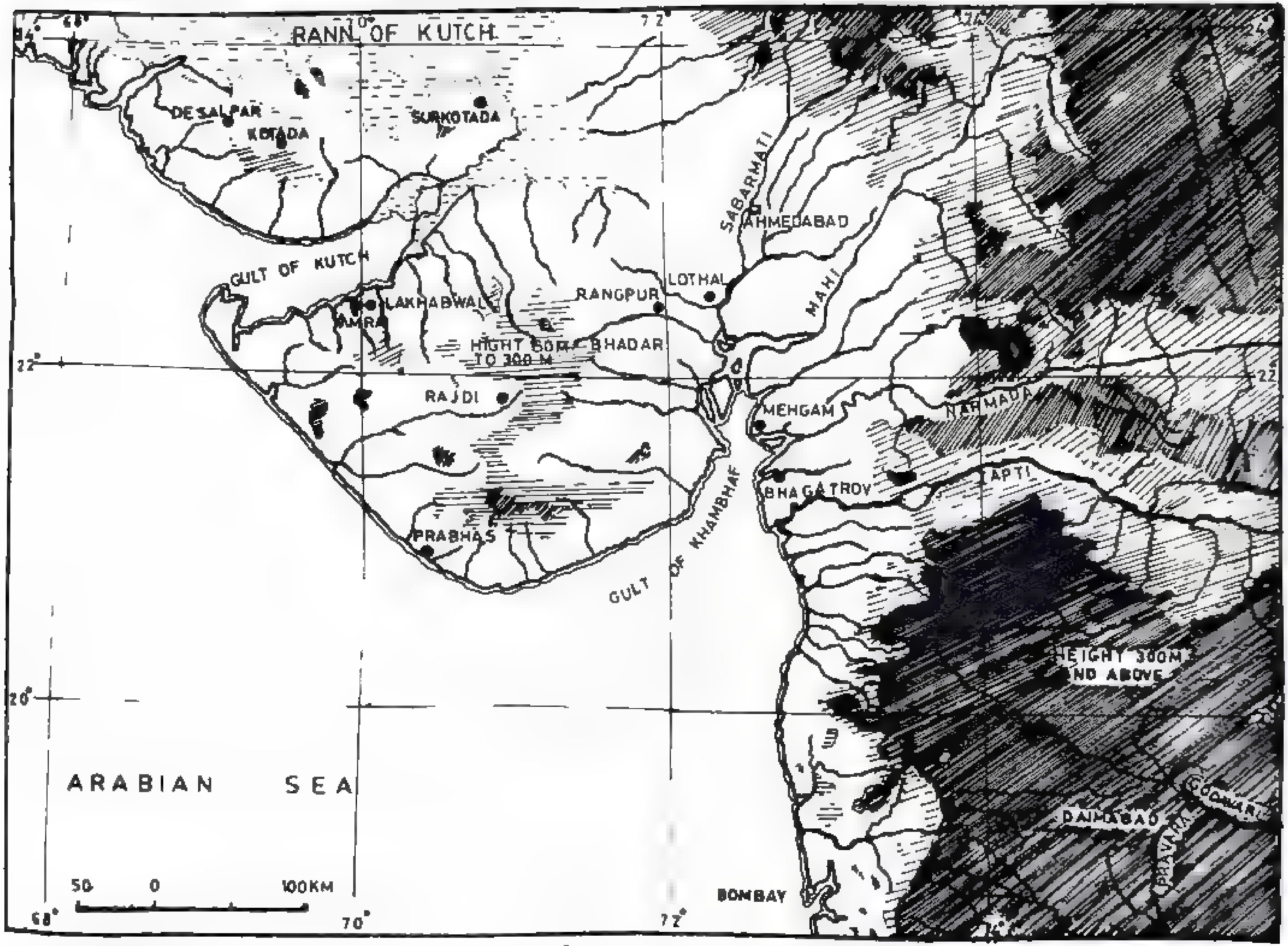
We must note here that the examples of horse remains from Mohenjo-daro and Harappa are not definitely stated to belog to the Mature Harappan strata. We have seen that from Mohenjo-daro Sewell and Guha have reported fragments of mandible of *Equus caballus* Linn.[720] Bhola Nath has also mentioned the presence of remains of the horse at a late level at Mohenjo-daro.[721] Interesingly, Mackay had remarked on the discovery of a clay model of horse from Mohenjo-daro that, the model in question, according to him, represent horse and that it would not be particularly surprising if the horse proved to have existed quite early at Mohenjo-daro.[722] Bhola Nath has also reported that bones of horse were found in the unworked collections from Harappa with the Zoological Survey of India.[723] Nath mentions that the horse remains were obtained from Area G at the end of the Harappan Civilization where alien invaders overran this prehistoric city and destroyed it.[724] In eastern

Pubjab, at Ropar the true horse has been reported to be present in the late period of the Harappan Culture.[725] At Kalibangan, we have noted above, the occurrance of the remains of true horse has been reported.[726] At Surkotada, in Gujarat, we have already seen that the animal is supposed to have been present from the earliest levels belonging to the Mature Harappan phase. It continued to exist in the piriod IC[727] which represents an occupation by a people using a white-painted black-and-red ware akin to the Ahar ceramic in Rajasthan, although Harappans continued to live here and are represented by the typical Harappan painted pottery.[728] At Lothal the presence of the true horse has been reported by Bhola Nath from the late period of harappan culture.[729]

R. H. Meadow, has put a lot of question as to the accuracy of these reports and inferences drawn therefrom. Firstly, he points out that few of the remains have been documented with sufficient measurements, drawings and photographs. Moreover, some of the specimens might have belonged to later strata and has been wrongly identified with the earlier sequences. Lastly, he states that distinguishing the different species of *equid* is quite difficult. North western South Asia is the home of *Equus hemionus* Khur or onager of half-ass. The true ass *Equus asines asinus* has also been reported to be present among the faunal assemblages of many sites prior to the appearence of the horse. It is often difficult to make distinction between these three types of animals from the fragmentary osteological remains. R. H. Meadow asserts that from the published photographs of the "horse" of Surkotada it appears that the animal represented is actually a half-ass albeit a large one.[730]

In the circumstances, it becomes quite difficult for us to ascertain whether the horse had come into the sub-continent during the Late Harappan period. In view of the total evidence for the true horse from the above-mentioned sites, it may tentatively be said that the animal might have strayed

INDUS CIVILISATION : DRAINGE SYSTEM IN SOUTHERN REGION



Indus Civilization = Drainge system in southern region

MAP – VI

into the Indian sub-continent via Central Asia somewhere in the second millennium B.C. in some regions of the Sind, Baluchistan, the Gujarat and the Punjab. But the extreme rarity of these instance makes it uncertain whether it was domesticated by the men in these regions as early as the beginning of second millennium, even if the true horse has existed. But one thing is certain that the animal had not been domesticated to any significant extent and hence its importance as a domestic beast in the economy had not yet become a fact in the Harappan-Late Harappan context. It is very much doubtful whether the animal was a member of the domestic stocks of the herdsmen of these times.

V

LATE HARAPPAN

The first half of the second millennium B. C. saw a general decline of the urban Harappan culture in the regions that we have been traversing so long. An overall disintegration of cities and towns and the emergence of smaller, more nebulous settlements concentrated in fertile region is noted. The glamour of the social life and flourishing trade were things of the past. But, as S. P. Gupta correctly points out, although most of the civic amentities were lost, the basic subsistence economy and technical know-how of agriculture and animal husbandry is 'generally preserved, albeit sometimes a little altered'.[731] There appears a phenomenal lack of standards. The bias was in favour of a rural economy in which there was little room for large-scale and diversified industrial production. Herein lies the direction of change that S. P. Gupta spoke of. This rural economy depended more emphatically upon agriculture and animal husbandry, in absence of large-scale industrial and trading activities that were present earlier. In the circumstances, small-scale subsistence farming must have sufficed. The herds of domestic animals met the needs for animal-protein in diet. But whether, the need for transport and pack-animals was as

great as during the Mature Harappan period is doubtful in the absence of large-scale trading activities.

It appears that the Harappans of these days, i.e. towards the end of the thrid and the beginning of the second millennium B.C., were adapting themselves sucessfully to widely different ecological settings and were moving eastwards toward the eastern Yamuna Valley and the Ganga-Yamuna doab. Their farming economy had no doubt flourished in these settings. We must note that most of these settlements were located, of necessity, near rivers, streams or natural lakes, and the people were utilising the fertile soil near these water-sources for their farming activities and also drawing irrigation facilities. Moreover, the alluvial river plains were not so thickly forested as the lands further interior. Hence the early settlers settled down in these areas. The practice of animal husbandry was an inseparable part of the economy and the cattle was the primary source of food and animal energy.

Before the passing on to the lands east of the Indus, in the eastern Punjab, Haryana and Uttar Pradesh, we would like to discuss some interesting evidences from one post-Harappan site in the Kachi Plain, east of the site of Mehrgarh. Pirak, lying on the east bank of the Nari river, has yielded some evidences for the presence of the bactrian camel as well as some indications that the horse was probably known to the settlers. Although the bones of the camel have not yet been studied in detail, as R.H. Meadow declares, yet the terracotta figurines that are available throughout all the periods at the site (C 1700—750 B.C.) all represent the two-humped bactrian camel, *Camelus bactrianus*.[732] Meadow asserts[733] that the figurines of Pirak indicate that the early camel of north western South Asia was the two-humped Bactrian species, individuals of which in later times were bred with dromedaries of Arabian origin to produce the hybrids so desirable for caravan purposes as R.W. Bulliet points out.[734] We have already noted above

Meadow's views regarding the indentification of *camelus dromedarius* at Mohenjo-daro and Harappa.[735] Hence we cannot be certain as to the exact type of the camel that had been domesticated at either Pirak or Mohenjo-daro. Harappa and Kalibangan or Gujarat. Only one thing is certain that a type of camel had been domesticated in these regions and the animal was traversing the regions of Baluchistan, Sind, Rajasthan and Gujarat, between the third and the second millennium B.C. J.F. Jarrige and J.F. Enault report that some of the terracotta figurines of the two-humped camel are painted in the bichrome pottery style that have been recovered at the site. One she-camel has realistic udders.[736]

The site has yielded a few realistic figurines of the horse, with a hole in the back for setting a tail. They are of different sizes.[737] However, no equid bones have been recovered from these early layers. R.H. Meadow reports that the first bones of the horse at Pirak come from the first millennium B.C. (period III).[738]

The other domestic species that occurred at all the layers at Pirak are the cattle, sheep, goat, pig (Boar) and some kind of dog.[739] Lastly, we must mention that a very few figurines of the cattle also occur in the early layers. One cow figurine display realistic udders like the she-camel figurine noted above.[740] Thus there was no overall change in the picture of animal husbandry in the post-Harappan context in Baluchistan.

Coming to the eastern regions we find that here also there was no appreciable qualitative difference in the techniques of animal husbandry, although quantitatively, the herders had much less pressure on them for now there was little need for feeding large numbers of non-producing urban dwellers. Nor was there a concentration of large populations at each site any more. The sites were smaller, population pressure was no more concentrated. However, the lack of

direct evidences of faunal remains at the Late Harappan sites here (barring the report on faunal assemblage from Rupar) restricts us to making only general assumptions about the state of animal husbandry in this context.

At most of the sites in the regions of Punjab, Haryana and western Uttar Pradesh we now find co-existence or overlap between Late Harappan traditions and other cultures, indrgenous to these regions, like the Bara Ware Culture or the Ochre Coloured pottery culture in these times, around C 1700 B.C. Thus and intermingling of different cultures are noted and a new cultural environment emerged.

At some of the sites that bear traces of the Late Harappan culture, we encounter such artifactual evidences as terracotta wheels and toy cart-frames as well as bull figurines, as we have found in the pre-Harappan and Mature Harappan contexts. These occur at Rupar in the phase IB levels where we note a mixed Harappan-Baran ceramic assemblages.[741] The remains of the domestic ass come from here, as well as that of true horse already noted.

The site of Bara, six miles south-west of kupar, is a single culture site yielding the typical Bara Ware.[743] However, in the middle levels the Harappan contact is clear.[744] The site yielded terracotta bull figurines.[745] The occupation at Bara may be dated around C 1800 B.C.[746]

Kotla Nihang Khan, south east of Rupar, bear traces of a Harappan occupation in phase I. The phase II levels saw the continuation of the Harappan Ware and traditions are also the introduction of the Bara Ware. Terracotta animal figurines, cart frames and wheels have been recovered.[747]

At Dher Majra, five Kms north-east of Rupar[748] a fragmentary animal figurine and toy cart-frames in terracotta have been recovered.[749] Y. D. Sharma regards that the assemblages at this site mainly belong to the Bara Culture.[750]

The site at Chandigarh yielded the typical Harappan

pottery with the characteristic painted motifs;[751] bangles of copper; four inscribed sherds, two of which bore full inscriptions written in the Harappan script etc.[752] Terracotta toy cart-frames, wheels and bull figurines occur at this site.[753]

These were the bigger settlements of this period in the eastern Pubjab. The smaller settlements also yielded similar evidences. At Dadheri in the Ludhiana District terracotta wheels and a painted bull have been recovered.[754] Nagar in Jullundur District yielded terracotta animal figurines.[755] K. N. Dikshit holds that while Rupar and Chandigarh survived as urban centres on a small scale, Dadheri, Nagar etc. were the village sites corresponding to these bigger settlements.

Meanwhile Haryana was also witnessing the gradual degeneration of the Harappan urbanity around C 1700-1500 B.C.[756] Banawali period III cultural assemblages, for example, are devoid of all classic elements of the preceding period. The features were closely akin to the Bara Culture. Bricks were not in use. Structures were made of packed earth. An astounding resurgence of the pre-Indus painted motifs and pottery forms is noted. The pottery of this period is termed the Banawali-Bara Ware.[757] There are no direct evidences for animal domestication here. At Mitathal the terracotta toy cart-wheel continuous to occur in the Late Harappan phase.[758] However, the models of wheels appear to have become comparatively thicker and smaller in size.[759] This may indicate that though there was a continued use of actual life-size carts drawn by domestic animals, these had degenerated into smaller and cruder varieties as a result of rustification. Bhagwanpura in the Kurukshetra District, Haryana, witnessed a Late Harappan occupation in period IA. A terracotta bull from this site having long horns and a pinched-up hump,[760] leaves no doubt as to the familiarization of the zebu cattle in this region.

We have already seen that the Mature Harappan Culture had penetrated into Uttar Pradesh in the Ganges Yamuna Doab. Hulas, where we note the occurance of

Harappan Red Ware as well as non-Harappan red and Thick Grey Ware, has yielded terracotta animal figurines and cart-wheels with raised cultural hub.[761] Bargaon, where the plain, painted and incised Harappan Wares coexist with the Ochre-coloured Ware, has yielded a bull-headed toy cart in terracotta. Wheels with central hubs were also present.[762] The continuation of these Harappan features of modelling toy carts, wheels and animals, especially the bull, in clay, has a great deal of significance. This not only indicates the continuation of Harappan artistic traditions, but also a regular use of real carts drawn by animals such as bulls. We may note that the toy cart-frames of terracotta occur at the bigger sites and also at other sites in Punjab and Haryana where traces of urbanity could be noted like Kotla Nihang Khan, Dher Majra and Mitathal. Thus it seems that although there was an all-round decay setting in on the urban phase of the Harappan culture, there were still some vestiges of that life that continued to exist in the subsequent times. The wheeled vehicles drawn by domestic pack animals may have still existed in these settings, although their instances might have become rarer. The necessity for and practice of cattle-drawn carts existed in the small urban centres, despite the overall shift towards a rural way of life. On the other hand, Dadheri and other small sites like Bhagwanpur depict the typical village settlement where life was much simplified. That is not to say that animal herding for food supplies had in any way been reduced in importance. In fact, in a village economy small-scale agriculture and mixed herding were more the way of life. The vedic civilization, which was the epitome of the rural civilization in India, treasured its domestic beasts as the verses in the vedic literature declare. Things were certainly not any different around the villages of the Late Harappan phase. What is required is further excavation at most of the sites and newer areas that may yield more direct evidence for the food-economy of the people of that period.

In Gujarat also the degeneration of the Mature Harappan culture was setting in. At Lothal B, Rangpur IIB and IIC this modified Harappan culture was manifest. Lothal B has been dated by S.R. Rao between C 1900 to C 1400 B C.[763] Bhola Nath reports the presence of *Bos indicus* or humped cattle, *Bos bubalus bubalis* or buffalo, *sus cristatus* or pig, *Ovis vignei* or sheep and *Capra hircus aegagrus* or goat in the periods IIB and IIC at Rangpur.[764] We have already noted the presence of horse at later Harappan levels at Lothal and also at Surkotada IB and IC. Many other sites in Kathiawar exhibitied the modified or Late Harappan culture for example Kindar-Khera, Lakhabawal, Devaliyo, Babarkot, Alan, Bhimpatal, Akru, Rojdi, Adkot and so on. In other parts of Gujarat also the Late Harappan is evident.[765] Speaking generally of the Harappan and Late Harappan settlements in Gujarat, Y. M. Chitalwala asserts that cattle-farming was an integral part of the Harappan and post-Harappan economy. He also reports the presence of cattle, goat, sheep, dog and both domestic and wild dog from the Late Harappan site of Khanpur.[766] The bones of buffalo were also recovered from Rangpur. No doubt all these domestic animals graced the scene of animal husbandry in Gujarat around the first half of the second millennium B.C.

VI

OTHER CHALCOLITHIC CULTURES

OCHRE-COLOURED POTTERY SETTLEMENTS :

In the Ganga-Yamuna Doab, we note that around C 1700-1600 B.C. a number of settlements sprang up characterised by the Ochre-Coloured Pottery (OCP). In many instances we find that the Late Harappan traditions and the OCP co-existed as at Ambkheri. K. N. Dikshit points out that the Late Harappan over-lapped with the OCP culture in the Upper Doab.[767] Interesting evidences of this kind has come from Rajasthan also. The excavations at Lal Qila[768] and Atranjikhera[769] in the Uttar Pradesh have

pushed the date of the beginning of the OCP culture much earlier around C 1800 B.C.[770] There are the two sites that have yielded interesting informations regarding the economy of the OCP people in the Doab region.

The mound of Atranjikhera lies on the western bank of the Kali Nadi, a tributary of the Ganges, in the Etah District in Uttar Pradesh.[771] Around the first half of the second millennium,[772] the site was occupied by the OCP folks. The period I level was evidently flooded by the Kali Nadi and perhaps remained water-logged and this may be responsible for the lack of usual habitational signs. However, burnt-bricks and mud-bricks have been recovered which might have formed bath-room floors. A large number of pieces of burnt clay-plaster indicate that houses were generally made of wattle and daub.[773] A considerable amount of Ochre coloured Pottery has been recovered.[774] D.R. Shah, who has analysed the faunal remains from Atranjikhera report that the period I level (C 2000-1500 B.C.)[775] associated with the OCP, yielded the remains of the *Bòs indicus* or the Indian humped cattle.[776] As R.C. Gaur points out, the animal was evidently domesticated.[777] Some of the bones were charred and display sharp cut-marks[778] indicating their having been chopped and used in the diet. The plant remains, which we shall discuss in the next chapter, show that the settlers were agriculturalists. Cattle-herding was a corollary of the agricultural economy.

Lal Qila in the Bulandshahr District[779] dated around C 1880 B.C. by mean thermoluminiscent dating,[780] yielded substantial habitational remains. A rammed earth floor ; clay plastered floors reinforced with potsherds rammed horizontally onto them and a series of post-holes ; the use of mud bricks in the later phase ; a mud-platfrom associated with a corner of a probable house ; debris of burnt-bricks and mud-bricks etc. comprise the indications of such structures. Moreover, the occurrence of reed and bamboo-marked burnt plaster, mud-clods indicates the existence of huts of

wattle-and-daub. Thus it appears that both huts and brick-built houses were in vogue at the site.[781] Lal Qila also yielded a well-preserved red-pottery varying in shade from ochrous to brownish, which was not only wheel-turned and well-burnt but was well-decorated with incised designs, graffiti, paintings with black pigment. Among the painted motifs the most significant is the depiction of an elongated humped bull, having prominent crescent horns, muscular thighs and a slightly raised tail, on the shoulder of a pot.[782] R.C. Gaurs reports the occurrance of a large number of animal bones including those of the humped cattle. The cut-marks on many bones suggest that the settlers were partaking of beef.[783]

The combined evidences from Atranjikhera and Lal Qila indicate that the OCP folks in the Ganga Yamuna Doab were simple agricultural folks who lived in small semi rural settlements, practised farming and herded the cattle. The penetration of the domestic cattle into the Ganges-Yamuna Doab is clear. We have already noted the presence of this animal in the neolithic context in the Ganga Valley in a domesticate state. It appears that the wild cattle in the region had long been domesticated and the OCP folks organised their life around the locally available resources. The association of the cattle with agricultural economy in the Ganges Valley signify the commencement of earnest farming in the region on a subsistence level in these times. Later we shall find that this subsistence agriculture will grow into surplus extensive cultivation levels, around the subsequent PGW and NBP Ware Cultural periods.

Quite interestingly, in these early days the incidences of sheep and goat do not occur. The densely forested Doab region with the clearing available only on the river banks, did not provide ideal forage for these species which primarily thrived on small shrubs and bushes in the mountains regions. In the circumstances the cattle bore the whole burden of providing meat and milk for the early settlers in

the Doab region and also of carrying men and goods. It may also have worked in the cultivation fields. The situation had not yet reached the heights where a mixed-stock herding could be achieved. Neither was it so necessary in these early times. At the site of Saipal in the district Etawah, where we find the occurrence of Copper Hoards associated with the OCP, we find the same situation. Some bones of the *Bos indicus*, the humped cattle have been recovered. The people here lived in huts of wattle-and-daub.[784]

At Ambkheri in District Saharanpur, we note some cultural affinities with the Harappan material recovered at Alamgirpur, Bara, Bargaon and Rupar, which indicate Late Harappan influence at Ambkheri which is primarily a settlement of the OCP Culture. From this site terracotta animal figurines, including those of the humped bull and cart-wheels with central hub prominent have been recovered.[785] These features have also been borrowed from the above Late Harappan sites. One thing is certain that the OCP folks in the Ganges-Yamuna Doab were exploting the cattle to a great extent. These regions had already entered the threshold of a full-fledged farming economy that was to provide the basis for higher standards of life here.

we have already mentioned that the Ochre-coloured pottery has also been recovered in the Rajasthan. This stateshad already been occupied by the pre-Harappan Sothi people and the Harappans and hence the subsistence economy practised by these people must have continued to be in vogue atleast in the north-western part of the state. However, the excavations at Jodhpura in Jaipur district and further explorations near Ganeshwar did not yield any direct evidence for the practice of animal husbandry. The debris in these sites are characterised by the Ochre-coloured pottery and an abundance of copper implements.[786] R.C. Agrawala and Vijay Kumar assume that these OCP people in Rajasthan were still in a hunting stage, considering the nature of their copper repertoire, which comprise mainly of weapons.[787]

However, nothing definite can be known about their economy at the present stage and it would not be correct to assume that these technically highly skilled people were mere hunting-gathering folks, only on the basis of our understanding of the nature of their copper implements, which actually may have been used in several other ways.

KAYATHA CULTURE

While the Mature Harappan was degenerating into a de-urbanised Late Harappan in the Sutlej plains and the valleys of Sarasvati and Yamuna, the Malwa region in western India was witnessing the growth of settled habitations and farming cultures. The Kayatha Culture was the earliest to have developed in Western India. Named after the type-site at Kayatha,[788] a small town 15 miles east of Ujjain, the culture is characterised by a fine sturdy pottery with thick brown slip and paintings in violet or deep red. The other ceramic types are the Buff Painted Red Ware and the Combed Ware.[789] The site of Kayatha is located on the banks of the river Kalisindh, a tributary of the chambal. As Wakankar rightly assumed the first settlers began to inhabit the site when the region was densely forested. He also pointed out that these people had their cultural epicentre at some other place and came to settle here attracted by the rich fertile black cotton soil and availability of water.[790]

M.K. Dhavalikar, who along with Z.D. Ansari, re-excavated the site in 1968,[791] suggests that the authors of the Kayatha culture appear to have formed part of the pre-Harappan or Early Harappan community.[792] These earliest inhabitants appear to have occupied only a small area of the ancient site. No complete house-plans could be recovered. But available evidences show that the people lived in houses of mud. The floors were made of river silt plastered with mud and the roof above was supported by wooden posts. The people used both stone and copper tools. Wakankar has reported the discovery of terracotta bulls

showing prominent hump and horns but without any head, ears or legs.[793] If as, Dhavalikar suggests, the kayatha people were really an offshoot of the Harappans then it may have been that they carried the tradition of terracotta bull figurines down into the Malwa region. M.K. Dhavalikar points out that this occurance of terracotta bull figurines may have had some religious significance. The bull figurines are of two types, naturalistic and stylised.[794] The only decoration on these figurines consist of nail marks over the body. Dhavalikar finds in this a similarity of treatment with some Harappa terracotta objects that also bear nail marks.[795] These figurines seem to have been used as votive offerings or might have been suspended in the neck by means of thread as medallions of religions import like totemical objects. As Dhavalikar mentions the bull-cult has a 'hoary antiquity' in India.[796] We have noted its prevalence in the Harappan context. To us, the significance of the bull-cult lies in the people's growing realisation of the animal's value and a gradual dependence on that animal in some important spheres of the economy. K.R. Alur points out that the animal bones recovered from the early level at Kayatha mostly belong to the bovine species and suggests that the Kayatha people had domesticated cattle.[797] He has also pointed out that the study of bones recovered from Kayatha revealed the developments of turned-out toes and turned-in hocks which indicate that the movement of the animal was restricted — a feature of domesticated animals.[798] Evidently, domestic species were kept in stockades or even harnessed at a spot for long times that would result in such developments. The Kayatha Culture has been dated between C 2000 and C 1800 B.C.[799]

BANAS OR AHAR CULTURE

Around C 2000 B.C. a new culture flourished on the banks of the river Banas in south-east Rajasthan.[800] We have already noted that a copper using OCP community

was inhabiting the regions of eastern Rajasthan around the C 2500-2000 B.C. time range. On the other hand the pre-Harappan Sothi or Kalibangan I culture and the Mature Harappan Culture had already been prevalent in northern Rajasthan who brought a high cultural standard in that region. In the context of the Banas Culture we shall note that a simple agricultural folk began to occupy south-eastern Punjab from C 2000 to 1400 B.C.[801]

Ahar, the major settlements of the Banas or Ahar culture is located in the Udaipur District. The entire region is watered by the Banas, the Chemical and their tributari. The ancient site is sifuated just overlooking the Ahar river which had laid down a rich fertile silt on bath its banks in the ancient times. The normal vegetation consists of scrub forests and a variety of palm. The settlers made an utmost utilisation of the natural surroundings.[802]

The people had seven types of ceramics of which the most characteristic was the black-and-red ware which occurs throughout period I.[803] They lived in houses whose plinchs were made of schist, abundant in the locality. The walls were made with mud or mud-bricks, the sloping roofs may have been thatched with grass or bamboo. They possessed a varied copper repertoire. Evidence for the use of rice and millet have been recovered.[804] Coming to the faunal remains we find such domestic species as the cow, buffalo, goat, sheep, pig, fowl, dog and ass.[805] The bones comprise largely of domestic animals, a very large bulk belonging to the *Bos indicus* (cow).[806] D.R. Shah, who has examined the material, points out that this overwhelming quantity of cattlebones suggests domestication and possibly breeding of the animal.[807] Some of the bones are charred and some bear signs of having been cut by sharp instruments, indicating that the animal was slaughtered for food.[808] The cattle bones occur throughout the phases Ia, Ib and Ic at the site.[809] The remains of the goat *capra aegagrus* are

fewer than those of the cattle but nevertheless fairly numerous. They occur at all the phases of period I.[810] the remains of sheep are present in lesser numbers.[811] The pig[812] is represented more along with the dog.[813] The remains of ass are very few.[814] D.R. Shah also reports the occurrence of a few bones of the buffalo (*Bos bubalus bubalis*) but states that the fragmentary nature of the few samples available makes it difficult, as she points out, to tell whether they belong to a cow or a buffalo. But she also asserts that wherever possible, the bones of the two species have been distinguished, and she comes up with a few samples.[815] The remains of the fowl consisting of only two samples come from the period IC level.[816]

Besides these faunal remains of domestic animals, we come across a number of terracotta bull figurines from Ahar. Most of these figurines depict pronounced humps and some of the figurines have short body while a few have an elongated body. These bull figurines come from the periods Ib and Ic.[817] Quite interestingly a toy figurines of an animal resembling the horse has been recovered from the levels of period Ib (Fig. 109, No. 15). The model has a hollow body with the legs and mouth broken, with pinched ridge indicating a mane and pinched ears.[818] However, in view of the absence of the remains of the animal at Ahar, and the lack of evidence for the existence of that animal in the region at the time, the importance of this figurine must not be overestimated. Radio-carbon dates from the site places the period Ia between C 1940 and 1765 B.C. ; period Ib around C 1725 B.C. ; and period Ic between C 1500 and 1270 B.C.[819]

Explorations have revealed the existence of about fifty sites of the Banas or Ahar Culture which are mainly confined to the Banas river valley.[820] Gilund is an important site of this culture. The Banas Valley, watered by the Banas and its tributaries, is sufficiently fertile to harbour a farming people who practised mixed herding. The occurrence of

copper deposits in the neighbouring region may have been an added attraction for the people. The grass on the fertile silt on the river banks provided good forage for the cattle, which dominated the herds of the peoples at Ahar. Sheep and goat thrived well on the scrubs available in a wider region. Small-scale agriculture was facilitated in the river valleys.

MALWA CULTURE

Around C 1700 B.C.[821] the Malwa Culture flourished in Central and Western India, characterised by the Malwa Ware, a buff or red or orange slipped pottery painted in black or dark brown, the use of copper and stone tools and small settlements where the people usually lived in huts of wattle and daub. The Malwa culture spread over a wide geographic region. The evidence shows that the Malwa people first occupied the Narmada Valley and began to spread out in Central India and finally moved Southwards in the Deccan. Thus the Malwa people occupied tracts of fertile regions in the Tapti Valley, pockets in the pravara-Godavari basin and the Bhima Valleys.[822]

Maheshwar, on the northern bank of the Narmada, in Nimad district, and Navdatoli, almost exactly opposite on the southern bank of Narmada, were two of the major sites yielding evidences of the Malwa Culture. Just about this place the Valley of the Narmada broadens considerably and leaves large alluvial tracts on either side.[823] The fertile soil attracted the settlers, who were not yet adept at cultivating on the rich black cotton soil away from the alluvium on the river valley. The people lived in square, round or rectangular houses with probably flat roofs. The walls and ceilings were made of clay mixed with grass and supported by split bamboos. The floors were made of lime and yellow or black clay. The hearths were well-made.[824] There are evidences of agriculture[825] and the use of copper implements.[826] The faunal remains from Navdatoli indicate the presence of the

Bos indicus or humped cattle, *sus cristatus domesticus* or pig, *capra aegagrus* or goat and *ovis vignei domesticus* or sheep. The last is very scarce whereas the remains of cattle are prodominent followed by those of the pig.[827] Besides these a terracotta figurine of bull with stumpy legs and a tail shown in an applique method is interesting in that it resembles the style of the Indus Valley figurines.[828] Moreover, two terracotta wheels have also been recovered from Navdatoli. The excavator points out that though wooden wheels were absent, yet 'these terracotta specimens should imply the existence of larger wooden carts'.[829]

At Eran in district Sagar we come across the Malwa Ware in the period I deposits.[830] The river Bina here takes a horse-shoe turn and surrounds the site on three sides. The fourth side was protected by a mud-rampart and a moat. This defence-wall belongs to the phase II of the chalcolithic period I.[831] No structural remains of the period were found except for a roughly circular fire pit with slightly raised brunt walls.[832] Interesting is the animal motif painted on the black-and-red Malwa Ware which depict dogs and a goat-like animal. Among other objects terracotta animal figurines have been recovered.[833] On a close inspector of the photograph on plate X B,[834] we assume that they depicted bulls, for the humps are prominent and one or two are with horns.

Along the left bank of the Pravara river the Malwa Culture extended over to the Maharashtra. At Daimabad, in District Ahmednagar.[835] We note that appearence of the Malwa Ware in phase III occupational level.[836] It is interesting to note that recent excavations have revealed the existence of the Savalda Ware Culture in the earliest occupational levels here. This was followed by a late Harappan Culture Phase, according to S.A. Sali, which is marked by the remarkable discovery of pottery sherds bearing the Indus script.[837] This strata has been dated between C 1800 B.C. and C 1600 B.C.[838]

Here, we would like to mention that four massive pieces of bronze sculpture have been recovered from Daimabad.[839] There is a controversy raging around their origin. However, S.A. Sali and M.K. Dhavalikar,[840] the excavations of the site, are of opinion that the said metal sculpures belong to the Late Harappan sequence at the site.

Of these four samples, the heavist one depicts an elephants standing on a cast copper platfrom with four brackets pierced beneath probably to hold axles and wheels. There are figures of a rhinoceros and a buffalo standing on cast copper platfroms. But the fourth object is by far the most interesting. It consists of a two-wheeled chariot with a standing human rider, drawn by two yoked oxen attached to the chariot by a long metal pole.[841] This sample is unique, as yet having no parallel amongst artifacts of the previous periods anywhere, except perhaps a slight link with the copper chariots from Harappa and Chanhudaro. The antiquity of the bronzes have been questioned on the grounds of their massive size and the presence of arsenic in them For, we have seen that copper was relatively scarce around Daimabad and it has been pointed out that the copper implements of the chalcolithic central and Western Indian sites do not possess arsenic in them.[842] However, to this, Dhavalikar points out, that as the bronzes belonged to the Late Harappan phase at Daimabad it may have been probable that the items were imported into Deccan from Harappan centres of outer regions.[843]

The significance of these artifacts cannot be correctly judged. For, even if we accept Dhavalikar's opinion, and assume that ox-drawn vehicles were not absent around the Late Harappan sites to the north of Daimabad, their import into this site do not make that practice a certainty around Daimabad itself. It has also been suggested by Dhavalikar that the Daimabad bronzes may have had some religious significance which accounts for their massiveness. They

may have been used in religious processions, drawn by the people. The bronzes may have been sculptured on the order of some ruling authority or religious priest with the consent of the whole community who all contributed to the cost of making them.[844] In that case these pieces were special and had no relevance in common life. So we regard that there were no parallels of such elaborate ox-drawn chariot in day-to-day life, although the existence of ox-drawn carts on lesser scales cannot be absolutely ruled out.

Around C 1600 B.C. the pottery of Malwa fabric begins to appear in small quantities at Daimabad, indicating the arrival of a new people. The Malwa people at Daimabad used copper sparingly[845] and lived in mud houses whose floors were embedded with potsherds, often having sacrificial altars.[846] There are evidences to show that the Malwa settlers were engaged in agriculture.[847] However, no report on faunal remains are available. Yet, we can assume, on the basis of the total evidence, that the people may have practised animal husbandry also.

The culture spread further south in Maharashtra. Inamgaon, located on the right bank of the river Ghod, a tributary of the Bhima which belongs to the Krishna system, yielded the vestiges of the Malwa Culture in the period I levels. These first settlers occupied the site from C 1600 to C 1400 B.C..[848] The pioneering farmers came from Malwa and they seem to have been attracted by the perennial waters of the Ghod river. The houses built by the Malwa people were spacious and large but were situated close to each other. Dwelling pits were also dug by the side of the mud houses.[849] The Malwa folks at Inamgaon had a mixed economy of farming, herding and fishing.[850] The excavations have revealed a large number of animal remains, cattle being present in overwhelming numbers followed by sheep, goat and pig.[851] Evidently, the people were more concerned with providing animal protein for the diet than with trans-

port matters. However, M.K. Dhavalikar and G L. Possehl point out that these animals, especially the cattle, also provided labour,[852] perhaps in agriculture.

Nagda, on the bank of river Chambal yielded the remains of a large number of domestic animals. The Bos indicus is present in overwhelming numbers. The remains of sheep and goat are fairly numerous and those of buffalo fewer.[853] Prakash, another Malwa Culture site on the junction of the Tapti and Gomai rivers yielded a number of terracotta bulls.[854]

The Malwa Culture (C 1700 — 1400 B.C.)[855] was essentially a culture of small scale farming people in the regions of Malwa and the Deccan in the valleys of Godavari — Pravara, Tapti and Bhima. the Malwa folks practised small-scale agriculture of cereals and legumes in the riverine tracts and carried on mixed-stock animal farming. cattle being the most common domestic animal. Pig. goat and sheep make up the rest of the stocks.

JORWE CULTURE

Around C 1400 B.C. another new culture associated with the Jorwe Ware, arrived on the scene in Maharashtra. The Godavari-Pravara valleys are the cradle of this culture. The alluvial tracts in these basins provided the base for the culture at Daimabad[856] and Nevasa,[857] the major sites in this region. At Inamgaon[858] also the Malwa cultural phase is followed by the Jorwe Culture as at Daimabad. Chandoli[859] and Songaon[860] in the Poona district are other sites yielding the Jorwe Ware. This ware has been names after the type site Jorwe[861] in the Ahmednagar district.

At Daimabad the Jorwe Ware comes with all its characteristic types, some of which bear the so-called potter's mark.[862] The Jorwe people here lived in circular, rectangular or square huts.[863] A very important feature of the Jorwe habitation here was a sort of embankment erected at the site

with a view to protecting it from river flood. The limited excavation did not yield the answer as to whether this construction was a form of fortification. As Dhavalikar points out, this building indicates a tremendous community effort and the resources that were at command.[864]

As to the economy of animal husbandry, an interesting scene of procession depicted on a terracotta cylinder seal exhibits a horse drawing a cart, followed by a deer. A long necked animal, perhaps a camel, preceded the horse-drawn cart. This is very striking.[865] As to the indentification of the horse, there is no certainty. However, the case of animal drawing cart can be accepted and taken to reinforce the fact that pack animals drawing wheeled vehicles were in vogue around Daimabad.

Nevasa on the Pravara was settled around C 1500 B.C. by a people who used copper sparingly ; possessed the Jorwe Ware ; lived in mud houses having wooden posts and floors made with lime and clay ; buried their dead right under the house floors and lived primarily on animal protein largely provided by beef. However, rudimentary agriculture was also begun.[866] The faunal remains at the chalcolithic levels at Nevasa reveal the presence of the cattle (*Bos indicus*) in overwhelming numbers. Remains of goat are comparatively less. Wild barasingha, deer (*Axis axis*) and turtle were hunted for their meat. Pig is totally absent here.[867]

At Nasik there is ample evidence that the pig was present in considerable numbers,[868] unlike the evidence at Nevasa. J. Eapen, who has also examined the material from Nasik point out that this is indeed quite strange since Nasik and Nevasa are quite near each others.[869] Local preference might have played a role or it may have been that the inhabitants of Nasik regarded the pig easier to handle and keep whereas at Nevasa the preponderance of cattle would suggest that here earnest herdsmen were taking pains to

rear, graze and feed this animal. However, the cattle was also present at Nasik along with the buffalo, goat and sheep.[870] It seems that the technique of animal husbandry had attained a standard at Nasik to warrant a mixed-stock herding. From the evidences provided by Nevasa and Nasik it seems that here the Jorwe settlers had primarily depended on animal husbandry and hunting for their diet.

At Inamgaon, however, the Early Jorwe period (C 1400-1000 B.C.) witnessed prosperous conditions. The houses where the Jorwe people lived were large rectangular structures situated about a metre and a half from each other unlike during the Malwa culture phase.[871] The settlement now got extended in size,[872] suggesting an increase in the population. As at Daimabad, a huge embankment wall was constructed in the Early Jorwe period to divert flood.[873] However, during the following Late Jorwe period (III) the size of the settlement shrunk and clusters of round houses were built in tightly spaced units almost touching each other like beehives.[874]

The Jorwe people at Inamgaor cultivated a number of plant items and kept domestic cattle, sheep and goats.[875] We have already noted that the Malwa people here practised mixed herding although cattle was by far the most important animal. A similar situation existed in the Jorwe period.

Dhavalikar and Possehl suggest that in view of the considerable evidence for agriculture it may be assumed that animal protein comprised a less important element in the diet of the people. In the circumstances, the use of animal labour, as a purpose behind animal husbandry here, cannot be underestimated. The production of milk and wool or fibre were also distinct advantages drawn from the domestic herds.[876]

Dhavalikar and Possehl estimated the probable population at Inamgaon and the probable acerage of land under

cultivation and calculated the number of draft animals or rather cattle to be between 80 and 250 on the basis of the fact that on an average one bullock was required to plough 8 acres of land.[877] Moreover the diet requirement of the calculated population of 650 heads suggest that 100 to 150 milch cows would be necessary to meet the need. Dhavalikar and Possehl therefore assume that for a population of 650 people the requirement would have been of 180 heads of cattle and for a community of a 1000 people the requirement would have been of 400 heads of cattle. To this they add a half of the total number stated above and the number of cattle come to 270 or 600 in case of a population of 650 or 1000 respectively.[878]

Dhavalikar and Possehl then go on to point out that, considering the capacity of the land near Pune to feed cattle, it would require 218 hectares of land to feed 270 cattle.[879] They concede that not all the animals kept by the Jorwe people at Inamgaon were Bovids. Sheep and goat were also present.[880] However, considering the whole matter at hand Dhavalikar and Possehl suggest that to feed the above animals seasonal transmigration was practised by the herders around Inamgaon and the Deccan in general.[881] They also point out that such seasonal migration takes place even in the modern times. They go on to suggest that if this hypothesis of transmigration can be conclusively proved, it may also turn out to be that Inamgaon was occupied only seasonal by the people in the Jorwe culture phase around the middle of the second millennium B.C.[882] At the end they state that they did not suggest that all the ancient settlements of the time in the Deccan and Malwa were seasonal encampments. But they offer that both seminomadic and fully sedentary ways of life were observed among the people in these regions in the second millennium B.C.

If we accept the above suggestion it would indeed appear that animal domestication had formed the most important part of the subsistence economy. For agriculture

required a settled way of life to be practised. However, the calculations and estimations of Dhavalikar and Possehl cannot be corroborated in the absence of more substantial supportive evidences. On the other hand, we have Y.M. Chitalwala[883] who points out that the mode of approach taken by Dhavalikar and Possehl is not entirely free of the dangers of being wrong. The most important points raised by him are that Dhavalikar and Possehl have played down the role of the game-hunting and the protein that it provided while calculating the number of cattle required ; they have also forgotten to mention the grainhusk or straw-fodder, as well as leaves and stems that were a good food for the animals (the first is indeed one of the chief foods of the cattle nowadays). Lastly, the authors have assumed on the basis of mud houses at Inamgaon that the site was occupied seasonally,[884] whereas, Chitalwala states, the evidences from sites of West Asia in the same stage of economy (where mud houses were in vogue) indicate that sedentarism preceded the stage of effective food-production.[885] In fact, as we have been noting so long, most of the sites not affiliated or related to the urban Harappan milieu yielded the remains of mud-houses or huts. Would it not be totally incorrect to assume that all these sites were temporary habitations ? Finally, Dhavalikar and Possehl themselves have admitted that their hypothesis regarding the nature of the settlement at Inamgaon is not susbstantially proved.[886] However, they provide Food for thought.

Thus, we conclude that the Jorwe culture, essentially a farming culture, saw the rise and development of a civilization in central India and the Deccan, the context of which was chalcolithic. The life-style was sedentary in general, pertaining to a food producing stage of economy where small-scale agriculture on riverine tracts and a mixed herding of cattle, goat, sheep and as evident at Nasik, pig, played a major role. The practice of this mixed herding may have required the growth of a class of specialised herders

who moved in search of newer pastures with their herds and thus the practice of transmigration may have been introduced which is still noted in the region. But basically the settlements belonged to sedentary farming folks. As we shall note in the next chapter, agriculture was very much in vogue.

EASTERN CHALCOLITHIC

The regions in the eastern India, Bihar and West Bengal, saw the emergence of chalcolithic culture after C 1500 B.C. We have already noted that Chirand in District Saran, at the confluence of the rivers Ghagra and Ganga had witnessed the rise of a neolithic settlement around C 1500 B.C. (period I).[887] Now, excavations have revealed the occurrence of copper objects even from the top layers of period IA.[888] The structural evidences of this period are provided by prepared floors and thick chunks of brunt clay with reed impressions.[889] The sub-period IB saw the continued occurrance of the black-and-red Ware. A large number of animal bones and remains of birds and fishes were found.[890] We have already seen that ox and buffalo were the domestic animals whose remains were associated with most of the strata of period I.[891] The evidence from the neolithic-chalcolithic overlap at the end of period I suggest that there were not much difference in the practice of animal husbandry between the neolithic and chalcolithic occupations at Chirand.

Further east, away from the Ganga Valley, in the valley of the river Ajay in Burdwan District, West Bengal, the ancient site at Pandu Rajar Dhibi[892] also witnessed the appearance of the chalcolithic culture around C 1100 B.C.[893] The Ware of the period include the black-and-red Ware the painted red ware and other ceramics.[894] A number of floors of houses made of laterite or *moorum* with signs of post holes and lumps of clay bearing read impressions indicate that the people lived in huts of mud plastered with reed and

supported by wooden posts. A heap of brunt clay tiles may represent the type of roof.[895] The people domesticated pig and humped cattle as indicated by the remains of these animals. They also hunted the Sambar deer.[896] We may refer here to the recent studies conducted by Manomoy Ghosh and Utpal Saha[897] on the animal remains at Pandu Rajar Dhibi. They repeat the earlier findings that pig, goat and buffalo have been indentified at the site. They make a few pertinent remarks that, pigs and buffaloes are animals which prefer to live in damp, marshy lands whereas cows and goats preferred comparatively high and drier grounds. Their food habits also differ. "Therefore to maintain these animals simultaneously, it requires adequate knowledge in animal husbandry." They are also of the opinion that as the people at the site were practising agriculture at the same time, it may be assumed that the animals, were also deployed in ploughing and allied jobs in agriculture. They are right in assuming this but this is true only in case of buffalo and cattle whereas goat and pig are purely farmed for food. Thus a mixed motivation operated behind this mixed stock husbandry. As to the handling of the different animals, it must be remembered that buffalo and the Bos. Species are familiar animals in eastern India. In the same district of Burdwan, the site of Mangalkot has been extensively excavated.[898] The site yielded remains of habitations, in the form of prepared floors, a number of hear the discovered. The pottery was the typical black-and-red ware. A large number of animal bones have been found in great numbers — both domestic and wild. Domestic species include cattle, sheep, goat, buffalo and pig, showing the same taxa as found at Pandu Rajar Dhibi. Period I is dated between C 1200 B.C. and 60 B.C. However, this stage also yielded signs of the use of iron tools. Hence the evidence may be taken to cover for a wide span of time and. cultural continuity.

A number of protohistoric chalcolithic sites have been discovered through explorations in the valleys of the Ajay,

Kunoor and Kopai rivers. However, as yet little is known about their subsistence economy.[899] Only at Mahisdal, in the Birbhum District, on the north bank of the Kopai do we come across the evidence for the occurrence of rice.[900] In the circumstances, we can only assume that cattle and pig were the domestic animals kept by the farming people here to meet the dietary requirements.

SOUTH INDIA

At the end we would like to touch the faunal evidence from South India in the chalcolithic context. We have already seen that the humped cattle, sheep, goat, buffalo, ass and dog have been domesticated during the preceding Neolithic period which began around the end of the third millennium and the beginning of the second millennium B.C. The evidences for stock-herding and probable breeding of atleast cattle is overwhelming in the South Indian neolithic sites. Therefore, we find that the technology of the animal husbandry was flourishing in South India since the early second millennium B.C.

Here, we would like to touch the evidences from Hallur before we pass on to a new cultural phase. Hallur in district Dharwar, on the left bank of the river Tungabhadra, reveal the presence of a chalcolithic culture co-existent with the upper neolithic in the period II sequence. A sudden profusion of copper objects is noted while the coarse brown-and-black ware of the previous neolithic period continued to predominate the ceramic repertoire. The houses were circular on plan as indicated by the positions of post-holes. The floors were made of rammed schist chips. Circular hearths were noted.[901] There are evidences that some sort of cultivation was practised.[902]

K.R. Alur reports the presence of remains of the Bos indicus or cattle, buffalo, sheep and goat.[903] His examination of the bones reveal the occurrence of marks of deformity or bony exostosis on the joints of the legs which

indicate that the animals had suffered the strains of heavy pressures.[904] It appears that the domestic species at Hallur were carrying burdens. Moreover, the defunct metacarpi in the manus of the horse and cattle from Hallur indicate the long evolution that these animals have already undergone[905] which in itself is a pointer toward the domesticated state of that animal. The domestic fowl was also present at Hallur. But most important is the presence of a few bones of horse at the site.[906] However, we may note that this phase of occupation at Hallur not only saw the overlap of Upper Neolithic and Chalcolithic but also the introduction of the Megalithic culture and the radio-carbon dates for this phase places this context around C 1000 B.C.[907] In view of this, it may not be totally unacceptable that the horse had made its appearance at this time in the south in Karnataka. It was about this time, perhaps a little earlier, that it was arriving on the scene in Northern India along with the dawn of the Vedic civilization.

The chalcolithic context in the Indian sub-continent therefore saw the origin and development of the techniques and processes of animal husbandry throughout the different regions. Evidently, there were still some pockets where the economy had not attained the heights required to carry on that practice with efficiency. However, all in all, the advantages of animal domestication and husbandry had dawned upon the people of the different cultures of our area. The cattle had come up as the most useful domestic animal providing milk and labour throughout the lengths and breadths of the Indian sub-continent. Sheep and goat were popular with primary farmers. The ass was limited to certain regions, where the need for transport was substantially present. The dog was not uncommon a friend of the people. The buffalo was slowly becoming a familiar animal but was kept in small numbers at certain sites, as evident from the finds. For this animal thrived in some special ecological settings, like the marshy or swampy regions in deep tropical areas.

Likewise the camel was also present only in certain regions and in even smaller numbers. Indeed its utility was restricted to desert areas and hence it was more evident in western and north-western regions of the sub-continent. Lastly, a few cases of the horse having appeared on the scene in the latter half of the second millennium B.C. have been registered. This was the situation in which we find India at the beginning of the First millennium B.C.

VII

IRON-AGE CULTURE AND EVIDENCES FROM THE VEDIC LITERATURE :

The beginning of this new millennium witnessed the emergence of a new culture associated with a new ceramic, the Painted Grey Ware. This new culture spread over a wide region, from the drybeds of the Sarasvati, Drishadvati, through the valley of the sutlej into the Ganga-Yamuna Valleys and doabs, where this culture reached a height of civilization.[908] This millennium saw the origin of the new technology of iron metallurgy which first appeared in the Swat Valley in north-west around C 1000 B.C.[909] and spread further east around C 700 B.C.[910] and flourished in the context of the southern megalithic cultures around C 600 B.C.[911] And most interesting was the advent of the Aryan speaking people. The Allchins are of opinion that the first spurt of the Aryan movements into the sub-continent took place at the 'opening of the second millennium'. The 'Early Vedic' stage according to them lasted down to C 1500 B.C., followed by the 'Mature Vedic' stage. The 'Late Vedic' stage, according to them, lasted from C 1300 B.C. to C 600 B.C.[912] Thus we find that with the first millennium B.C. our sub-continent is thrown into a vortex of novelties, a new colourful civilization taking birth as a result.

We have to remember that, at the beginning of the first millennium B.C., the iron technology had just made its entry into India proper, and even at the Gandhara Grace sites,[913]

the occurrence of the metal had no far-reaching effect on the socio-economic fabric as yet. Here, we must mention that at Katelai, a Gandhara Grave culture site, two horse burials in separate graves, presumably alongside their masters, have been noted. A bronze model of a horse has also been recovered.[914] From Timargarha, again, an iron cheek-piece of a Snaffle bit has been found.[915] From the above evidences, it seems that the horse had not only been domesticated already by these people here but had also become an important beast to man so as to merit the great attention paid to it as indicated by the use of these metal ornamentations in the early days when metals especially iron were used only on important occasions.

At Pirak in the Kachhi plains, near the Nari river, we have already noted the occurrence of a late Harappan phase of occupation in the early levels. Here, iron begins to appear in the intermediate levels.[916] The excavations have yielded the remains of bones of the horse (Equus caballus) in period III (C 1000 B.C.), equid figurines in terracotta, as we have seen earlier, come from period I onwards.[917] Remains of the cattle, camel, sheep, goat, pig and some kind of dog come from all the levels.[918]

It seems, that basically the economic structure remained at the level of a rural life and as far as animal husbandry was concerned the picture remained the same. It was only the entry of the horse into the scene that slightly altered the balance of the existing situation in the sphere of transport and other physical labours. We shall see that the vedic literature (C 1500 B.C. to 600 B.C.) provides a flood of information regarding the horse and its relationship with the human society. But for now we would like to study a few archaeological evidences from some of the Iron Age sites. It is unfortunate that vertical excavations at most of the sites have not yielded much information regarding the state of animal husbandry except some sites like Hastinapura and

Atranjikhera which provide substantial informations regarding animal husbandry.

At Hastinapura in District Meerut, Uttar Pradesh, the earliest layers belonging to period I yielded the Ochre-coloured ware.[919] The following period II is characterised by the occurrence of the Painted Grey Ware.[920] In the PGW levels at Hastinapura we note the occurrence of copper as the chief metal and iron slag appears only at the upper layers of this sequence.[921] The iron metallurgy developed full-fledged in the region by the Northern-Black-polish Ware phase. No definite house-plans were available within the limited area excavated. But walls of mud and mudbricks have been recovered. The discovery of some lumps of mudplaster with prominent reed-impressions suggest that the walls of some houses are made of reed plastered with mud. Evidences for the use of cereal have been ancountered.[922]

As to the faunal assemblage, Bhola Nath reports the recovery of bones of thirteen species of animals, majority of which were domestic. The remains of the humped cattle were by far the most common. Remains of sheep and goat were fairly numerous, while those of the domestic buffalo were fewer. The pig is well represented. The most important fact is the presence of the horse, Equus caballus L., during the Painted Grey Ware period. The people at Hastinapura also practised hunting and fishing.[923] B.B. Lal asserts that cattle-breeding had formed an important occupation of the Painted Grey Ware people at Hastinapura.[924] The bones found during excavations bear definite cut marks by sharp instruments. These bones mostly belong to the cattle, buffalo, sheep and pig.[925] Nath also mentions that a large number of the bones belong to young animals as at Harappa and Mohenjo-daro.[926] These two features indicate that beef, mutton and pork were definitely included in the diet of the people and also that domestication and breeding of these

animals was very much in vogue. The presence of young animal bones suggest breeding.

Alamgirpur in the same district has yielded the remains of Painted Grey Ware sherds in the period II which follows the Harappan period I levels,[927] that we have already noted. Large lumps of clay, sometimes burnt, with reed-impressions suggest that people lived in mud-plastered reed huts. A fragmentary mud-wall has also been recovered in the top levels of the period.[928] The people continued to use copper, but iron objects also occur throughout the period II.[929]

Of special interest to us are two terracotta wheeled toys, one representing a bull, the other a ram. The beautifully executed figures of the animals are provided with holes through the nostrils, evidently for putting through a string to draw the figures.[930] Wheeled animal figurines have been recovered from the Mature Harappan sites like Chanhudaro. However, we cannot link up these two traditions chronologically for the period I at Alamgirpur, belonging to the Harappan culture, has not yielded any such figurines.[931] The report in Indian Archaeology — 1958-59 — A review, states that the presence of these figurines in painted Grey Ware levels at Alamgirpur brought to light a new tradition.[932] Whatever the origin of these figurines, their presence may indicate the use of domestic animals like the cattle for draft purposes in this context.

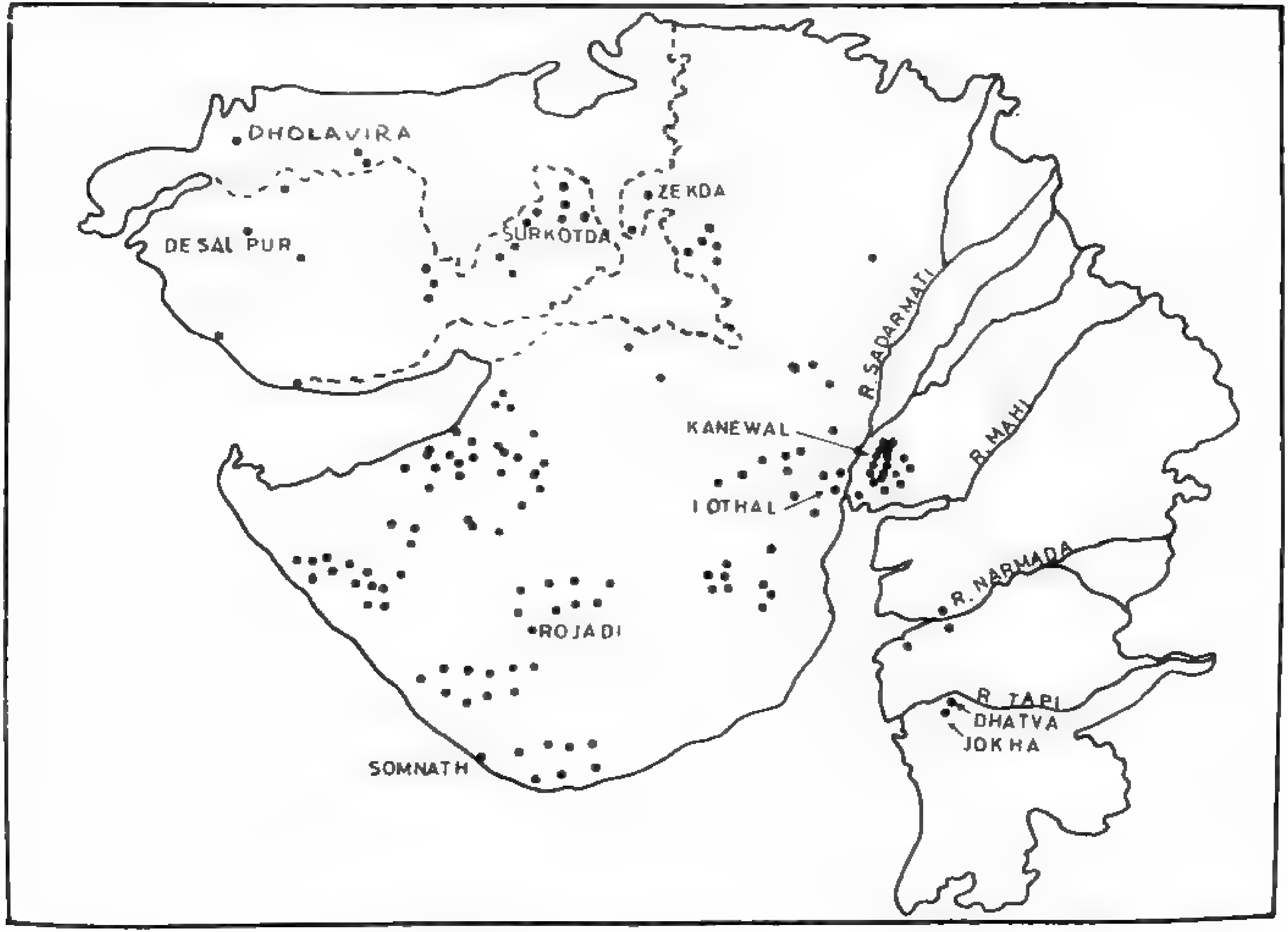
At Atranjikhera in District Etah the period III levels (C 1200 — 600 B.C.) are characterised by the Painted Grey Ware and the use of iron tools. Copper was also used. R.C. Gaur points out that the evidences indicate an association of the cultural remains of this period with the Aryans, atleast of the Later Vedic period.[933] The presence of post-holes over mud-floors, mud-plaster lumps with reed-marks indicate the existence of mud huts with wooden posts and thatched roofs. A few pieces of burnt and un-burnt bricks were recovered from the layers of the Upper Phase. The

remains of several domestic hearths and a potter's kiln indicate further structural evidence.[934] In the Early phase of this period the remains of a mud wall were recovered which might have served as a bund to protect the site from floods. This was raised immediately over the deposits of period II.[935]

The faunal assemblage at Atranjikhera period III, yielded the remains of such domestic species as the cow, buffalo, goat, sheep, pig, dog, and most important, the horse.[936] We have noted the presence of only the cattle in the OCP period at this site. Buffalo, sheep, goat and dog were added to the list of domestic animals at the site during the period II (Black-and-red Ware period).[937] The pig and the horse seem to appear for the first time during the PGW period. D.R. Shah mentions that, in general, the remains of young species of cow, buffalo, goat, sheep, pig, horse and dog suggest that these were domesticated.[938] The meat of cow buffalo, sheep, goat and pig were used in the diet. The bones of dog may have belonged to both street-dogs and watch-dogs or pet dogs. Horses were most probably used for transport.[939] A bone of the domestic fowl has also been recovered at the PGW levels.[940] But whether the bird was bred and used much in diet cannot be ascertained from this meagre evidence.

Thus, we find that at Atranjikhera the Painted Grey Ware people were keeping a large and varied stock of animals. Full fledged practice of animal husbandry is indicated. There are evidences of cultivation of a number of crops also.[941] Indeed, at Atranjikhera the picture of a vibrant rural life with a flourishing farming economy is very much in evidence. Among other artifacts a terracotta model of a humped bull and a model of a probable pig have been recovered.[942] Besides these, eighteen terracotta wheels have been recovered from the deposits of this period. R.C. Gaur suggests that some of these may have been spindle-whorls,[943] but some may have been model representations of actual

CHALCOLITHIC SITES IN GUJARAT



MAP-VII Chalcolithic Sites in Gujarat

life-size wooden wheels that were attached to vehicles. Infact the presence of the horse may signify that horse-drawn wheeled vehicles were in use.

Other important sites of the Painted Grey Ware in the Ganges-Yamuna doab as Allahapur,[944] Ahichchhatra,[945] Mathura[946] and others, yielded evidences which suggest a village society and economy during the PGW period. Noh in Bharatpur district, Rajasthan, yielded the Painted Grey Ware in period III levels. A number of iron objects have been recovered from this period. No direct evidence for animal husbandry is obtained.[947] At all these sites, however, we note that, life at this time centred around village-settlements. The socio-economic conditions were those pertaining to a farming society. The practice of agriculture is evident at many of the sites. Animal husbandry, as we have noted above, formed a part of the economy. But, more extensive excavations are required to obtain a more complete picture of the technique of animal husbandry. The horse, it seems, had definitely arrived. The radio-carbon dates available from different sites provide a time bracket of C 800 - 350 B.C. for the Painted Grey Ware period.[948] At most of these sites the Painted Grey Ware culture was replaced by the Northern-Black-Polish Ware Phase, deriving the name from that distinguished ceramic type. This period made its first appearance around C 600 B.C. at a few sites.[949] As far as animal husbandry is concerned not much evidence, significantly different from that obtained from the Painted Grey Ware period, has been available from this context from excavations.

The period IV levels at Atranjikhera (C 600 to 50 B.C.) associated with the NBP Ware [950] reveal that the structural traditions of the PGW period, viz., the wattle-and-daub huts, gradually disappreared replaced by structures of mud and burnt-brick,[951] This period has been sub-divided into four phases.[952] Of these, the earliest, i.e., phase A reveal

that although the previous types of huts continued to occur, yet mud-flood occur more frequently now.[953] This development in building activities indicate the first stirrings of a move towards a higher stage of cultural achievement. Iron objects continued to occur.[954] D.R. Shah reports the presence of remains of the cattle, buffalo, goat, sheep, pig, dog and horse.[955] Here, no difference is noted with the P.G Ware level finds. Plant remains indicate a flourishing state of agriculture with a multi-cereal cultivation having existed.[956]

We do not possess much direct information regarding animal husbandry from other excavated sites of the NBP Ware period, but, judging from the general evidences of life-style at these settlements, we assume that towards the end of our period, i.e., the sixth century B.C., the first imperceptible moves were being made towards a higher standard of civilization than that existing in the P.G Ware period. At some sites like Kausambi, the signs of an incipient urbanity had been noted much earlier around the beginning of the first millennium B.C. The NBP period came here around C 650 B.C. which witnessed the continued growth of that settlement into an urban centre.[957] At many other sites like Hastinapura, Allahapur, Hulas, Prahladpur, Rajghat, Sonepur and others in the Ganges-Yamuna doab, the iron-age civilization with incipient urbanisation was making an appearance between C 600 and C 400 B.C.[958]

In the circumstances, we can assume, that the practice of animal husbandry was flourishing. All the domestic species that are currently utilised and kept by man have already been tamed and taken over around the PGW period. In the post Painted Grey Ware period these animals began to be utilised with more vigour and as the human society progressed towards a second urbanisation,the need for developing the economy and multiplying its advantages steadily increased. We shall find the references in the Vedic literature very useful to understand the situation.

The iron age dawned in eastern India at Pandu Rajar Dhibi,[959] Mahisdal,[960] Tulsipur[961] at the confluence of Kasai and Kumaru rivers towards the second half of the first millennium B.C. No direct evidence for animal husbandry is available. In Central India, Iron Age occupations were noted at some of the chalcolithic sites like Eran and Kayatha. At Ujjain also the Iron-age dawned in the middle of the first millennium B.C.[962] No radio-carbon date is available. This site has yielded evidences for animal husbandry in the form of faunal remains. Bhola Nath reports the presence of remains of mostly domestic animals like the cattle, buffalo, sheep, goat and pig. Moreover, both the domestic ass and horse were also present.[963]

Around the eighth to seventh centuries B.C. Central India saw the emergence of Megaliths associated with the iron. In the Vidarbha region megalithic grave sites as well as habitation sites have been excavated. The habitations at the site of Takalghat gives evidence of the presence of sheep, goat, pig, cattle and most important, horse. The stone circles (grave site) at khapa attested horse burial.[964] We may note that an ornament for the face of the horse was found over the skeletal remains of a horse in one instance. This was made of a copper sheet with a series of tapering Knobs rivetted at the back with iron pins. Moreover copper bells are also found over the skeletal remains of horses at Khapa.[965] S.B. Deo points out that it is quite evdent that the horses were buried with all their ornaments and trappings. Moreover, the inseparable association of the horse with the buried humans at Khapa is especially noteworthy.[966] The radio-carbon dates from Takalghat are 615 ± 105 B.C. and 555 ± 100 B.C. Another megalithic site near Nagpur, Naikund has the dates of 672 ± 115 B.C. and 655 ± 100 B.C.[967]

Thus, it is quite certain that the horse had become a prize beast in society around the seventh century B.C. in the

Maharashtra. It is probable that around this time the animal had gained the supreme importance as a beast of war, as its various trappings would indicate. The Vedic references corroborate this theory, and we shall see how the vedic people came to regard the horse as a Ksatriya among the animals.

Recent excavation in the Gujarat has revealed the emergence of iron age at Nagara and other sites like Dhatwa. R.N. Mohta reports that the occurrence of bones of cattle, goat and sheep indicate the practice of animal husbandry being carried out at these sites in Gujarat.[968]

Iron reached Hallur in Karnataka around C 1000 B.C.[969] in the overlap phase of the Neolithic-Chalcolithic-Megalithic.[970] We have already noted the domestication of cattle, sheep, goat and dog from the neolithic levels onwards at Hallur. The horse appears also in this overlap phase and was perhaps associated with the Megalithic element.

EVIDENCES IRON THE VEDIC LITERATURE

The history of the first millennium B.C. is very richly fabricated and the vedic literature is a very rich source of that history. A varied information regarding the socio-economic life of this millennium comes from these texts. The vedic Age has generally been distinguished into the Early and Later phases. The Early Vedic Civilization is portrayed in the Rig Veda while the Later Vedic Civilization can be construed from the other Vedas and associated literature.

The Rig Veda is generally assigned to the period from the fifteenth century B.C. to the twelvth century B.C.[971] From the numerous reference made to the importance of domestic animals in this text there can be no doubt that the Rig Vedic people were very much dependent on animal husbandry as an economy. The hymns in the Rig Veda often pledge to the gods for the well-being of their cattle and other live-stock including the ram, ewe and steed.[972] The goat,[973] *Ajā* was

another useful animal which was often termed as the *bastā*[974] The buffalo is also referred to in many hymns. In the early vedic period it was Yoked to the cart.[975] Interestingly, the use of the ass has been clearly portrayed in the Rig Veda where it is described as Yoked to the firmly jointed car and driving the *Aśvins.*[976] The Chariot is also described in details, to be a triple chariot with wheels and seats.[977]

But by far the most prestigious beast along with the bull or cow was the horse in the *Rig Veda.* The Vedic texts refer to *aśva* or horse, which was renowned for its speed.[978] The text describes how the strong steed, covered with trappings[979] is led by men thrice around[980] and then sacrificed,[981] the flesh of the animal then cooked[982] and eaten[983]. This undoubtedly is a reference to the horse — sacrifice or *Aśvamedha*. Various trappings of the draught animal are mentioned here as the halter, heel-ropes, the head-stall, girths and cords.[984] At the end it has been pledged that may the sacrifice of the steed bring riches and wealth in form of live-stock, good horses and many off-springs to those who observe it.[985] The hymn 156 in book 10 of the Rig Veda again describe the speed of the horse and pray to the god *Agni* for vast wealth in kine and horses. The use of horse as an efficient and strong beast in the battle-field is exemplified in another verse, which describes how the skilful charioteer quides his strong horses who drive the chariot show their vigour.[986] Interestingly, one verse describes how two tawny bay horses, favourite of *Indra,* are Yoked on both sides of his car.[987] This perhaps gives an indication that a personal feeling of possession and care had grown for the animal in the man who could afford to possess it in the Rig Vedic society. The horse was probably also used in agriculture, for ploughing fields.[988] Lastly, we must mention the Rig Vedic hymn which gives a beautiful and poetic appreciation of the virtues of the animal. It describes the strong steed which is faithful, victorious, obedient with his body in combat, how

the animal in battle field cannot be restrained by any force. The hymn goes or to relate the praises that people confer upon this powerful and speedy animal which gives men abundance.[989]

The Rig Veda refers to the cow as food that moves on feet.[990] The people welcomed the kine as bringer of fortune and put them into cow-pen or *Gosāla*.[991] The cattle is stated to roam over wide pastures and fatten even the worn and wasted men.[992] That the cattle was an extremely rich possession is indicated by many references to cattle-stealing and cattle-raiders.[993] The milk of the cow was a soothing drink for the Rig Vedic people and the milch-cows are described as lowing out to their calves from their stalls.[994] It appears that the milch-cow was kept separate from their calves for the utilisation of the milk by human beings. Milk and butter formed an important part of the diet.[995] The clarified butter was a must in all sacrificial rites.[996] For the possession of many cows, the *Gāvisti* rite was performed, which was a refined form of cattle-raid practised by the Rig Vedic people.[997] The oxen were used widely for ploughing the cultivation fields.[998] The cow was not to be injured.[999] The cow was declared as *aghnyā*.[1000] There is no direct reference to the meat of cow having been eaten. However the above declaration indicated that there were instances of beef eating in the Rig Vedic times. The archaeological evidences support this. But from the importance ascribed to the milch cow in the Rig Veda, it appears that the milch cow was beginning to be treasured most. Meat and milk were also provided by the goat,[1001] sheep[1002] and buffalo, the gods being prayed for the presentation of the last.[1003] The use of buffalo for drawing vehicles is again indicated.[1004] Lastly, we must mention that the dog was an assistant of the vedic men in hunting. The Rig veda refers to its use in the hunting of wild boars.[1005] The dog was kept in or near-about the house.[1006]

As to the herding of these animals, The Rig Veda refers to the *Gopa*[1007] or herdsmen who raised and protected the cattle and other domestic species, in general. The cattle was kept in pens.[1008] The animals grazed in large pastures.[1009] The Rig Veda also mentions the *Avipāla* or sheep-herder.[1010]

Thus, from all accounts, it seems that the cow and the horse were the most important animals in the Early Vedic society. The people were basically villagers, animal husbandry forming a very important part of their economy. In view of the fact that generally evidence for the cultivation of only barley comes from the Rig Veda, it seems that the Rig Vedic people were, by and large, primarily pastoralists. Kine and other domestic species were boons to them and they forever pledged to the Gods for the bestowal of domestic animals.

However, the Later Vedic society seems to have been far more advanced in the field of aggriculture and husbandry by comparison. The later vedic literature generally covers the period from C 1000 B.C. to the sixth century B.C.

As for the picture of the practice of animal husbandry gleaned from the later vedic texts, it must be mentioned that this continued to occupy an important position in the structure of economy in this society. The cattle, sheep, goat, buffalo, ass, dog and, last but not the least, the horse, were the major domestic animals as they were in the earlier society. It is interesting to note that the fowl, the presence of which is attested in the faunal remains from many excavated sites mentioned earlier, was not mentioned in the Rig Veda. But in the later vedic literature it has often been referred to.[1011] We have discussed the importance of this bird as poultry in the dietary economy of the pre-historic people in the sub-continent.

The cow, as already noted, continued to be the most useful and favourite domestic animal. The great importance attached to this animal is clear from the comparison made

in the *Śatapatha Brāhmaṇa* between this animal and the earth, as both of them fill and soothe man.[1012] People desired to possess as many cows as they could.[1013] A reference is made to the breeding of cow and their overwhelming number in the *Taittiriya Samhitā*.[1014] The person possessing a large number of cows is called a *gomātā*[1015]

The milch-cows held a special position in the Vedic society. As it was, the milk and butter of the cow were very important constituents of the diet. Hence, the life of a cow was very dear. The slayer *(goghāta)* of cow was punished with death penalty.[1016] We have already noted that one of the salient features of the Harappan society was the bull figurine and it has been assumed that this feature had a religious significance.[1017] Here, in the vedic society we again find that the cow was being ascribed a religious significance. The cow was declared *aghnyā* or not to be killed.[1018] This may have been on account of the economic importance of the animal.

However, there are evidence which suggest that beef was, nevertheless, eaten by the people on occassions. For example, the slaughtering of cow was done on three occassions, viz., the reception of guests, rites to the *pitrs* or the *Śhrāddha* (funeral) rites, and in marriage.[1019] The *Vāśiṣṭha Dharma Sūtra* relates that the offering of the meat of cow was a great delicacy to distinguished quests of the *brāhmaṇa* and *Kṣatriya* castes.[1020] That the practice of eating beef was quite general is reflected in the *Śatapatha Brāhmaṇa* which goes on to prohibit the sacrificer from eating beef during the period of the performance of a sacrifice as the cow and the ox undoubtedly support everything on the earth and must be cared for and protected. It declares that inspite of this if anybody adheres to that practice it would result in the destruction of every thing and the person concerned would be reborn as a strange deformed being.[1021] In the *Āpastamba Dharma Sūtra* there is a clear sanction of the eating of

beef.[1022] From these evidence it appears however, that beef eating was not a general practice. The gradual dawing of the realisation of the animal's value in the agricultural economy is shown in the growing sentiments against slaughtering of the cow. The present day Hindu strictures against eating beef has its roots in these sentiments recorded in the *Sūtras*.

The cows were milked thrice a day, in the morning, mid-day and evening.[1023] The milch cow was most often referred to as *Dhenu*.[1024] *Payasvati* was the designation of a cow yielding much milk.[1025] *Vilipti*[1026] and *Ghṛtācī*[1027] were special cows whose milk contained much more butter than the milk of other cows, such species are found even today. The male species, oxen, were mainly utilised for raising young animals. The bulls which were selected not to be castrated, *mahokṣa*[1028] or *uksanāga*,[1029] injected the cows with semen. It has been described as raining down offspring or increasing the seed very much.[1030] These oxen were often trained for ploughing the cultivation fields and were termed as *Vāha*.[1031] The *anadvāha* were those oxen who drove carts and seldom ploughed the fields.[1032]

The *aśvatara*[1033] or mule was another pack-animal in the Later Vedic society, bearing burden and drawing vehicles.[1034] But this animal was not as swift as the horse and was not normally attached to a chariot.[1035] The *gadarbha*,[1036] *Khara*,[1037] *rāṣabha*[1038] or ass was regarded as inferior to the horse.[1039] However, we have seen that they were Yoked to the chariot of the *Aśvins* and hence, it seems, that on occasions, especially perhaps of religious nature, the ass was Yoked to chariots also. It was a most suitable beast of burden.[1040] In the *aśvamedha* it was a sacrificial victim.[1041]

The *(Aśvamedha)* sacrifice of the horse which was regarded as a form of Agni,[1042] perhaps on account of its speed and power, brought the supreme political status to the

person who performed it, for the horse was ascribed the supreme position among animals.[1043] This sacrificial rite was therefore generally performed by political dignitaries in the Later Vedic age and indicates the use of horse among the noted political figures of the times. The horse had evidently become a prestigious possession and attained political significance. The person possessing horses was regarded as a fortunate man and was supposed to be blessed by the king of the Gods, Indra.[1044] Evidently, the animal had become the symbol of military power. On account of its courage it was considered as *Ksatriya* among the animals and was used on the battle field.[1045] We have already noted this use of the horse in the Rig Veda. On account of its speed, the horse has been described as the flying bird.[1046] *Asurāśva* was the term used to designate the fastest running horse.[1047] The Sind was renowned for its horses which were given the name *Saindhava*.[1048] A horse of this class, *Mahsahya*, was very mighty and high spirited.[1049] Like the oxen, the horses also were often castrated and were termed *nirasta*.[1050] The mares also drove chariots and carts and were known as *Aśvā* and *badavā*.[1051] The *Vājasaneyi Samhitā* has referred to several pieces used in trapping of the horse, viz. the halter or *Samdāna*, head-rope or *Sandana*, head stall or *Śirsanya*, and the girth or *raśana*[1052] (*Kaksyā*[1053] in the Nirukta).

The sheep or ram was an useful animal in the Later Vedic society, especially for its fleece. The ram was called *urana* and wool was known as *urṇā*, the word being derived from the root, *VP*, meaning to cover.[1054] Among the small animals the ram was considered very strong and was supposed to have been created by *Prajāpati* along with the rājanyas.[1055] The ram was also a sacrificial victim to different gods in various sacrifices.[1056] Therefore, its meat was also partaken by the people, for generally the sacrificial offerings were feasted on by the performers of the rites. As

we have noted in the Rig Veda, the Atharva Veda also mentions the *Avipāla* or sheep-herders who grazed and protected the sheep.[1057]

The *Ajā*,[1058] *chāga*,[1059] *basta*[1060] or goat was also very useful. It accompanied the sheep as a domestic animal (*ajāvayaḥ*) and was put to similar uses.[1061] The meat of goat was available and the milk of the animal, containing certain medicinal qualities, was very useful for children.[1062] The milk was also offered to gods to please them into bestowing plessings on the sacrificer.[1063] The cow and the goat were. like gold, items of exchange, and has been stated to be exchanged for *soma* plant from the *brāhmanas*.[1064] The *ajāpāla* or goat-herd was a professional member of the Later Vedic society.[1065]

The position of the dog seemed to have been the same since the Rig Vedic days. Its meat was never consumed, except in abnormal circumstances as a last resort before the desperately hungry, even in the Rig Vedic days.[1066] But as we have seen it stayed in friendly circumstances. The Śatapatha Brāhmaṇa declares that the dog was not to be considered as fit to be a sacrificial victim.[1067] The dog has been mentioned in the latter vedic texts as an useful animal in hunting.[1068]

We have already seen that the buffalo was used to draw carts in the Rig Vedic society. We now find that the beast was an object of gift offered to the priests[1069] and a sacrificial victim to gods.[1070] Therefore, it is implied that its uses were recognised by the vedic people. However, the rearing of a she-buffalo by the twice-born was regarded as a grave sin.[1071] It appears that it was only a fit profession for the lower castes.

The overall picture is that of a farming-pastoral society, where the people treasured their domestic stocks as personal property and as means of exchange ; where the value of domestic animals as gifts was tremendous ; where the

simple folks forever prayed to their various gods for blessings of numerous cattle, horse, sheep, goat and so on. Their religious sentiments led them to the assignation of some gods to the task of looking after the welfare of the domestic animals. *Pūṣan* was one of them, who appears to have been the god of the pastoral society. He increased the wealth in cattle[1072] and brought back the lost and strayed ones.[1073] He was the lord of the routes and guided the herdsmen.[1074] This indicates the wide region that the herders traversed while grazing the live-stock. It may also indicates some sort of transmigration from one region to another on their part. *Pūṣaṇ* supervised the cattle and caused their welfare.[1075] It should be noted that all these references came from the Rig Veda which goes to show the strong element of pastoralism in that society. In view of the tradition of pastoralism in Pre Harappan and Harappan contexts in the region of the Hakra Valley and Sutlej Divide, a region which was later inhabited by the first batch of Rig Vedic Aryans, this allusion to seasonal migration and pastoral activity can be explained not only in terms of an adaptation to the eco-geographical conditions in the region but also a link-up with earlier economic traditions. We may also point out here that *Pūṣan* was later replaced by *Rudra* as the God presiding over cattle wealth[1076] and that Rudra was later identified as an aspect of *Paśupati*, the latter having had a non-Aryan, and probably, Harappan, origin.

The profession of animal husbandry was a recognised occupation in the vedic society. The herder has been named variously as the *gopa*,[1077] *gopāla*,[1078] *pasupa*.[1079] The specialised keepers of some animals have been named seperately, the shepherd as *avipāla*,[1080] the goathered as *ajapāla*,[1081] the keepers of horses as *aśvapa*,[1082] and those of elephants as *hastipa*.[1083] The reponsiblities of the herdsmen were very serious and are enumerated by Gautama who stated that the cowherd was responsible for all dam-

ages caused to the animals under his charge.[1084] He also stated that the owner is equally responsible for the well-being of his domestic stock, but if they were placed under the charge of a herdsman then the latter will be completely responsible.[1085] In case of any damage the herdsman was liable to paying fines which was heaviest in the case of horses and buffaloes having been damaged and lowest in case of sheep and goats. This indicate the rarity and higher value of the horse and buffalo in comparision to sheep and goats. In case of destruction of crops by these domestic animals, fines were to be paid to the owner of the crops.[1086]

Another interesting feature of the animal husbandry reflected in the vedic literature was the branding of the domestic animals. It appears that the practice of marking animals was quite ancient. In the Rig Veda reference has been made to the cattle whose ear was marked with the sign of number eight and the cattle thus designated *Aṣṭakarṇī*.[1087] So, it may be assumed that the practice existed even in earlier times and was a common one among the Rig Vedic people. This practice indicates the prevalence of the notions of property-rights and ownership of moveable property like the cattle. It is not clear whether the concept of individual ownership had yet dawned upon the society but some sort of community-owner-ship must have been in vogue so that it was necessary to brand the domestic animal and assure that they do not get mixed with those of other communities. The later Vedic references show that the practice had become widely accepted *Lakṣaṇa* [1088] was the sign or mark that was branded on the body of the cattle, while *anka*[1089] was the act of marking or branding.

Stalls or pens were built for the cattle. The Aitareya Brahmana describes that the cattle-stalls were as essential as the houses for human beings.[1090] The cattle were driven to the pastures in the morning and returned to the stalls in the evening.[1091] The *gostha*, the resting place for cattle, was

some sort of enclosure with roofs.[1092] Here, we are remained of the early cattle-pens discovered at the neolithic ash-mounds in the South India. We have already described these structures that were generally surrounded by post-holes. The Atharva Veda furnishes us with informations as to how ideal cow-stalls were built in the Vedic Age. The ground was to be made smooth and clean so that the cattle could sit, stand, sleep and move with comfort.[1093] This indicates that the stalls had to be spacious. The provisions for adequates supply of water and fodder were made.[1094] The Atharva Veda states that such stables enabled the cows to be properly nourished and yield much milk.[1095] How far these advices were followed in actual life cannot be ascertained. We have not yet come across archaeological evidences for the existance of elaborate cattle-pens in the vedic context so far. However this stricture in the Atharva Veda reflects the realisation of the importance of live-stock and a concern for their well-being from the point of view of overall economy. In the cattle-pens the animals were allowed to rest freely and were normally not tied to wooden or bamboo pegs.[1096] The calves were generally kept a little away from the mothers so that they could not suck the milk as they liked.[1097] The animals were properly fed and pots made of bamboo were used to serve the fodder. The Vedic Aryan practices of animal husbandry reveal the development of certain technical and organisational improvements. First, we must note that the literature is full of terms specially associated with this occupation which definitely indicate a concious attempt at institutionalising the profession. We have the specialised herdsman-*Gopāla*. He is said to be so closely acquainted with animals that they acted according to his instructions.[1098] He was familiar with their habits, characteristics and defects. Besides there was specialisation even with herding occupation. *Avipālas*[1099] were shepherds; *ajāpālas*[1100] were goatherds and there were *asvapālas*[1101] and *hastipalas*.[1102] Besides, there was the practice of brand-

ing cattle, *Lakṣaṇa*, presumably to denote ownership. There was also selective breeding of special animals with an eye to abundant yield of milk or meat, or a swift animal for draught. Taken together the evidence conveys a conscious orientation and a planned profession with efficient techniques involved.

Gostha or the stockade in which the domestic animals were kept was an extremely significant feature in the Vedic life. It was so important that later social formations like the *gotra*[1103] originated from it. It is probable that in the early days the Aryan people, who were first settling down in new regions, entered into mutual agreements which were reached between several families together, to erect common enclosures for protecting their domestic beasts, their most coveted possessions. The families may have settled around these enclosures. Those families having common *gostha* belonged to the same *gotra*. A number of such *gotras* who also used a common pasture land, *Vraja* probably, likewise may have belonged to the same social group. Eventually, the *gotra* came to denote the sub-groups within one caste. All these evidences indicate the primacy of pastoralism in the Vedic economy.

We have come a long way from the early days of the neolithic times when man first tried his hand at interfering into the animal world around him. At the end of our period we note that man had domesticated a number of useful animals and had already thought out the best manners in which these could be exploited in each of the cultural contexts. The double-prong purpose behind animal husbandry, that of providing a ready supply of animal protein to human diet and provision of animal energy to lighten the burden of heavy tasks of draft and transport that required much physical power, were being effectively served.

Throughout our study we have noted that the cattle, once it was domesticated by man, rapidly gained in impor-

tance over other animals in the economy. For not only did it provide ample milk and meat but also served as good labour in the fields of transport and draft as well as in agricultural tasks. So much so, that much religious significance appear to have been attached to this beast. Sheep and goat, the earliest ruminants to have been domesticated for milk, meat, wool and fat, played an effective role in the economy of animal husbandry throughout our context. However, in a purely agricultural society their role diminished in importance after the advent of the cattle. Yet, wherever we find evidence for mixed herding, sheep and goat, especially the former appear to have been the favourite 'serve-all' stock to the herders. The buffalo was another domestic species that was utilised by man for providing meat and milk as well as for serving as a draft animal. However, it was less in evidence than cattle, sheep or goat. Interestingly enough, the pig appear to have been the most preferred domestic animal in the urban surroundings, especially in the Harappan context. It supplied abundant meat and proliferated rapidly. But what is more important, it required very little care, space and special fodder. It thrived on domestic refuse. We cannot be sure whether the pig was deliberately bred around the Harappan or even other settlements where they occur, however they were surely exploited by man for meat. Both at the levels of specialised herding of domestic species and a mixed farming as an appendage of agriculture, the live-stock provided the major security for societies in the form of living reserve of animal protein as a part of the diet. This partial security in food consumption provided the basis for an increase in population. Apart from the rural sites which we see proliferating in Gujarat, the Sutlej region, in Haryana, Punjab and even in the Deccan in various temporal settings, the growth of herding communities specialising in pastoralism are also evident in upper regions of Baluchistan, the Hakra region in the Pre-Harappan and Harappan contexts and in the 'Karnataka in the neolithic

context. The economy of animal husbandry provided the much required basis for spatial expansion of population and settlements over a wide region in the Indian subcontinent.

In the matter of transport, the cattle, as we have seen, provided a very good support throughout our period. Such services were also rendered by the swift and light ass or hemione. The evidence for camel is rare and it generally occurs in the north west of the sub-continent and might have provided transport in some instances. The second aspect of the technique of animal husbandry was concerned with the factor of providing physical energy in the form of animal labour. A careful selection was made by herdsmen and animal breeders of either those animals which were providing food in the form of meat and milk, or. physical labour as in the case of draughts animals. This second aspect was a later development in the economy and marks a superior technical stage. The breeder had to train the animals to these ends. The animals were harnessed to transports, and even to devices for lifting water for irrigating cultivation fields. The harnessing of animals to wheeled carts marks a leap forward in technological advancement. Like the introduction of railways, it revolutionised life by making possible speedy communications. But it was with the coming of the horse that a great stir was made in the human world in our sub-continent. This animal brought greater speed and power to the people. However, from the vedic references it appears that it was soon restricted mostly to political assignations. The horse was a decisive factor in war-fares and in political courier service in those days when diplomatic activities were rapidly gaining ground in a growing environ of political awareness and organisations. Thus the animal shifted from the economy to politics. However, rich merchants would employ the animal in trade also. The main burden of trade was, of course, borne by the ass and cattle. The utilisation of domestic animals in transport had

a great impact on overland trade. These draft animals not only made the task of carrying bulky trade goods easy and speedy but aslo facilitated the movement of a great quantity of goods from one place to another over a long distance. Thus the role of the domestic animals in the enhancement of trade cannot be overlooked.

As to the features of animal husbandry which reveal the advances made in that technology, we know that the practice of mixed stock herding is a sign of advancement. This we have noted in the urban Mature Harappan background at Mohenjo-daro, Harappa, Balakot etc., and to some extent at a number of the Chalcolithic sites in Central India and Deccan. Even at some neolithic South Indian sites we have noted this, for example, at Kodekal and Paiyampalli and in the Neolithic-Chalcolithic-Megalithic overlap phase at Hallur. In the Ganges-Yamuna Doab, we get evidence for mixed-stock herding from the Black-and-Red ware period onwards at Atranjikhera and in the PGW context at Hastinapur. In Later Vedic society mixed herding was very much in vogue. This feature denotes a great deal of organisation and an awareness of the advantages of a balanced supply of meat, milk etc. that a mixed herding of goat, sheep, cattle, pig and buffalo would provide. The practice of mixed-herding also indicates a richer economy at the primary production level.

There is also the feature of breeding and in case of cattle, the proliferate evidence for the humped variety (Zebu) cattle with prominent hump and long horns is probably an indication in this direction. This feature is also very much noted in the Later Vedic texts, where we find references to the milch-cow which provided more milk than the test,[1104] the horse which was more swift and powerful,[1105] the ox which provided stronger and more numerous progeny[1106] and so on. In fact in the evidences coming from the Later Vedic Society we see a highly organised state of the tech-

nique of animal husbandry. This was a sure sign of progress towards greater development in the economy as a whole.

In the absence of literary data, the archaeological sources of the previous periods fall short of supplying us with such interesting informations. However, in the Pre-harappan and Harappan milieu, the settlement patterns (the attention given by the settlers to the availability of forage for domestic herds as well as the optimum use made by them of the local environment to these directions), and artifactual evidences point out that pastoralism had been a specialised activity rendering a great service to the growing urban society in the Indus Valley. Pastoral nomadism had been a feature in this context, as also in the context of the South Indian Neolithic. We get evidences for camp sites of such pastoralists who practised seasonal migration with their herds. Our evidences from the north-western Neolithic context and Pre-Harappan and Early Harappan contexts suffice to show how these societies gradually provided an economic basis to the urban Harappan experience. Animal husbandry and agriculture gave the primary basis to that economy.

In the Central Indian and Deccan Chalcolithic context, where the economy was mainly limited to substence level due to the constrictions imposed by the ecological situation, animal husbandry formed an integral part of the economy. In some instances, as at Nevasa we only get evidence for animal husbandry and not agriculture. This was also true of many neolithic sites in the South India. It seems that at these settlements animal husbandry was the only organised production-economy that provided sustenance to human population, besides the primitive practices of hunting and gathering. Thus it appears that from the early neolithic times onwards, the domestic animals had given man a great deal of security as far as food requirements were concerned, even in the absence of the paraphernalia of a full farming economy.

In Northern India after the degenation of the urban Harappan Culture, the nature of the economy subsided basically to that of a rural society. The vestiges of urbanity were left in some pockets. In these settings animal husbandry did not fail to provide for dietary requirements as well as for transport. In the second millennium B.C. the cattle was the most popular animal in the northern India even in the OCP context. In the absence of a full-fledged mixed herding economy it would appear that the situation was not really rich as far as animal husbandry was concerned.

However, the situation was gradually changing for a more developed state of economy. In the Rg Vedic times, pastoralism was extremely important. In the later Vedic context, full-fledged agriculture emerged and animal husbandry reached a highly organised state. The development of the second urbanisation after the sixth century B.C. had at its base a strong economy with a surplus agriculture. An organised practice of animal husbandry was a part of that economy, as we have seen above.

Therefore, we can point out that as a technology animal husbandry played a very important supportive role in the development of civilization, as far as it provided for the basic needs of an along with agriculture. This is well exemplified in man's awarness of the value of domestic stocks which were regarded as extremely valuable possessions in the Vedic literature. In the barter society it was a medium of exchanges. The sense of property in relation to the domestic herds clearly clarify the place of animal husbandry in the economy around the sixth century B.C. as gleaned from the Later Vedic texts. It met the different requirements of the different societies in the varied ecological and economic settings. Man had indeed made animal husbandry an irrevocable part of the economy that led to the development of civilization in our subcontinent.

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CHALCOLITHIC SITES IN RAJASTHAN, HARYANA, UTTAR PRADESH, BIHAR, WEST BENGAL AND ORISSA

KEY

1 AHAR	9 ALAMGIRPUR
2 GILUND	10 LALQILA
3 KHURDI	11 ATRANJIKHERA
4 JODHPURA	12 SOHGAURA
5 GANESHWAR	13 CHIRAND
6 MITATHAL	14 MAHISDAL
7 BHAGWANPURA	15 PANDU RAJAR DHIBI
8 BARA	16 BHARATPUR

17 BARUDIH

MAP XII

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1009. Ibid, 1.10.2.

1010. Ibid, 8.34.3.

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1013. AV, 19.31.61.

1014. TS, 6.5.10.1.

1015. VS. 26.4-5.

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1020. VDS, 4.8.

1021. ŚB, 3.1.2.21.
1022. AP. DS, 1.17.30.
1023. TS, 7.5.3.1.
1024. AV, 5.17.18 ; SB, 2.2.1.21 ; Nirukta, 11.42.
1025. AV, 13.1.27.
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1028. ŚB, 3.4.1.2.
1029. VS, 28.32.
1030. Nirukta, 9.21.
1031. TS, 5.6.21 ; AV, 6.102.1.
1032. TS, 6.5.21 ; AV, 3.11.5 ; VS, 20.30 ; AB, 1.1.4.
1033. AV, 4.2.8. ; AB, 3.47 ; ŚB, 12.4.4.10.
1034. AB, 4.9. ; CU, 4.21.
1035. TS, 7.1.1.2-3.
1036. VI, 1.22.1.
1037. ŚB, 5.1.2.15.
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1043. Ibid, 5.4.12.1.
1044. AV, 20.25.1.
1045. ŚB, 6.4.4.12 ; 12.2.2.17 ; AB, 13.2.2.5.
1046. VS, 23.12 ; ŚB, 13.2.6.15.
1047. VS, 29.12, 15.
1048. ŚB, 11.5.5.12 ; BU, 6.2.13.
1049. CU, 5.1.12 ; BU, 6.2.13.
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1053. Nirukta, 2.2.
1054. Ibid, 6.21.

1055. TS, 7.1.1.5.
1056. VS, 30.11 ; TB, 3.4.9.1.
1057. AV, 5.8.4.
1058. RV, 10.164.1.
1059. VS, 23.13 ; 21.4.3 ; SB, 3.3.3.4-5.
1060. AV, 8.6.12 ; BU, 1.4.9. ; TB, 1.3.7.7.
1061. AV, 8.7.25 ; VS, 3.43.
1062. TS, 4.1.6.1.
1063. TS, 5.4.3.2 ; Ibid 5.1.7.3 ; SB, 6.5.4.1.
1064. VS, 4.26.
1065. VS, 30.11 ; TB, 3.4.9.1.
1066. RV, 4.18.3.
1067. ŚB, 12.4.1.4.
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1070. TB, Books, 2-3.
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1077. RV, 1.164.31 ; PB, 24.18.
1078. VS, 33:11 ; SB, 4.1.5.4.
1079. AB, 4.1.1.
1080. RV, 1.114.9 ; 10.142.2.
1081. ŚB, 4.1.5.2. ; TB, 3.4.9.1.
1082. VS, 30.11 ; TB, 3.4.9.1.
1083. TB, 3.4.9.1.
1084. TS, 3.4.9.1.; VS, 30.11.
1085. GDS, 12.19.30.
1086. Ibid, 12.16.-18.
1087. RV, 10.62.7.
1088. AV, 6.14.1-3 ; 12.4.6.

1089. MS, 4.2.9.

1090. AB, 19.4.

1091. AV, 6.52.1.

1092. RV, 1.191.4 ; VS. 3.21 ; AV, 2.14 1.5-6 ; SB, 11.8.3.2 ; AB, 3.18 14 ; VS, 15.26.

1093. AV, 3.14.1-6.

1094. Ibid, 3.14.1.

1095. ŚB, 21.1.10.

1096. AV, 6.115.2-3.

1097. Ibid, 3.6.7 ; TB, 1.3.3.6.

1098. AB, 4.1.1.

1099. ŚB, 4.1.5.2.

1100. VS, 30.11.

1101. TB, 3.4.9.1.

1102. TS, 3.4.9.

1103. A. A. Macdonell and A. B. Keith, op. cit., 1958, Vol. I, p. 235.

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1105. CU, 5.17.15.

1106 Nirukta, 9.21.

CHAPTER II
AGRICULTURE

The story of human cultural development truly begins with the chapter on agriculture. 'Neolithic Revolution' had equally, if not more, far-reaching implications for the human society, as had the more recent Industrial Revolution. We have been seen the truth of this observation with regard to the implementation of the practice of animal husbandry on the part of man. Here, we shall observe the phenomenon of domestication of plants and note the effects of the same on the development of human cultural history in our context.

The relation between man and plants dates from the antiquity of man, when it consisted merely of gathering and collecting of wild fruits, grains and roots in the palaeolithic and thereafter, the mesolithic contexts. But, however indirect and small may have been his contact with the plants that proliferated around him, this was definitely the beginings of an awareness of the necessity of plant foods. From thence there were several steps to take before man reached the first technical stages of deliberate cultivation of some selected plants.

Alphonse De Candolle has offered us some factors that generated the first attempts at cultivation on the part of man. First, he points out, that such plants that were recognised by primitive man to have definite advantages which all men seek must be within reach in the wild state. So the consideration of productivity and easy growth of a plant were the factors behind the selection of plants for cultivation. Secondly, he points out that the climate should not be too rigorous, thirdly, there should be some degree of security and settlement ; lastly, there should be a pressing necessity arising out of insufficient resources in fishing, hunting and

gathering. This may arise due to increasing population pressure as well as due to an insecured supply of food.[1]

The process of recognition of those plants which are useful to man commenced in the Indian subcontinent in prehistoric times. In this context, we must note that wild plants had played a great role in the subsistence pattern of human society in our subcontinent from the very early days before they were selected and cultivated by man. In general, the pollen and archaeobotanical evidences from Indian suggest that a wide variety of cereal plants were used for subsistence long before the major species emerged into domestication. For example, from the Sambhar Lake in Rajasthan the first cereal type pollen grain was recorded in pollen diagram by Gurdip Singh. The date for this evidence falls around C 7500 B.C.[2] However, this evidence has been recently questioned by Vishnu Mittre, who points out that this may not necessarily indicate cultivation of that cereal. However, Vishnu Mittre himself have come up with pollen diagrams of exceptionally large-sized grass pollen grains from the Nal Lake in northern Gujarat, which may belong to wild grasses the likes of which are still cultivated by tribals in Assam.[3] Thus, it may have been that many cereals that are at present absent from the list of conventional and domestic plants, were actually used by the prehistoric man in this subcontinent previous to the beginnings of full-fledged agriculture.

As Vishnu Mittre points out[4] the inhabitants of this subcontinent became dependent on animal husbandry quite early. The early herdsmen in the course of grazing their herds came in close contact with fodder grasses and other plants preferred by the domestic animals. The value of these wild cereals and plants might have been observed directly from their effects on the domestic stock. Thereafter, the early societies may have lived upon wild cereals etc. for a long time. Natural hybridization as well as human selection may have resulted in the production of larger seeds and larger

sizes of plants.[5] These were selected and their seeds sown either by broad-casting or dibbling. Digging sticks were useful here. Thus began rudimentary agriculture. The practices of irrigation and manuring were not necessary or recognised as necessary in the beginning and were learnt gradually.

Agriculture heralded the beginnings of the settled life for man. Sedentarism was instilled in man who was used to a nomadic life till then. Man was now bound up with the land, with his surroundings. Homes and habitations began to be built on permanent basis. Family life started in earnest. Gradually the conceptions of kingship and political and social units matured. The attachment to land first aroused the senses of property rights and economic value of the material possessions. The barter economy took shape. Handicrafts developed and, in a settled life, proliferated to a great extent. Gradually, large scale agriculture enabled the development of a class of specialised craftsmen who produced both utility and luxury goods and the march was made in the direction of an urban society.

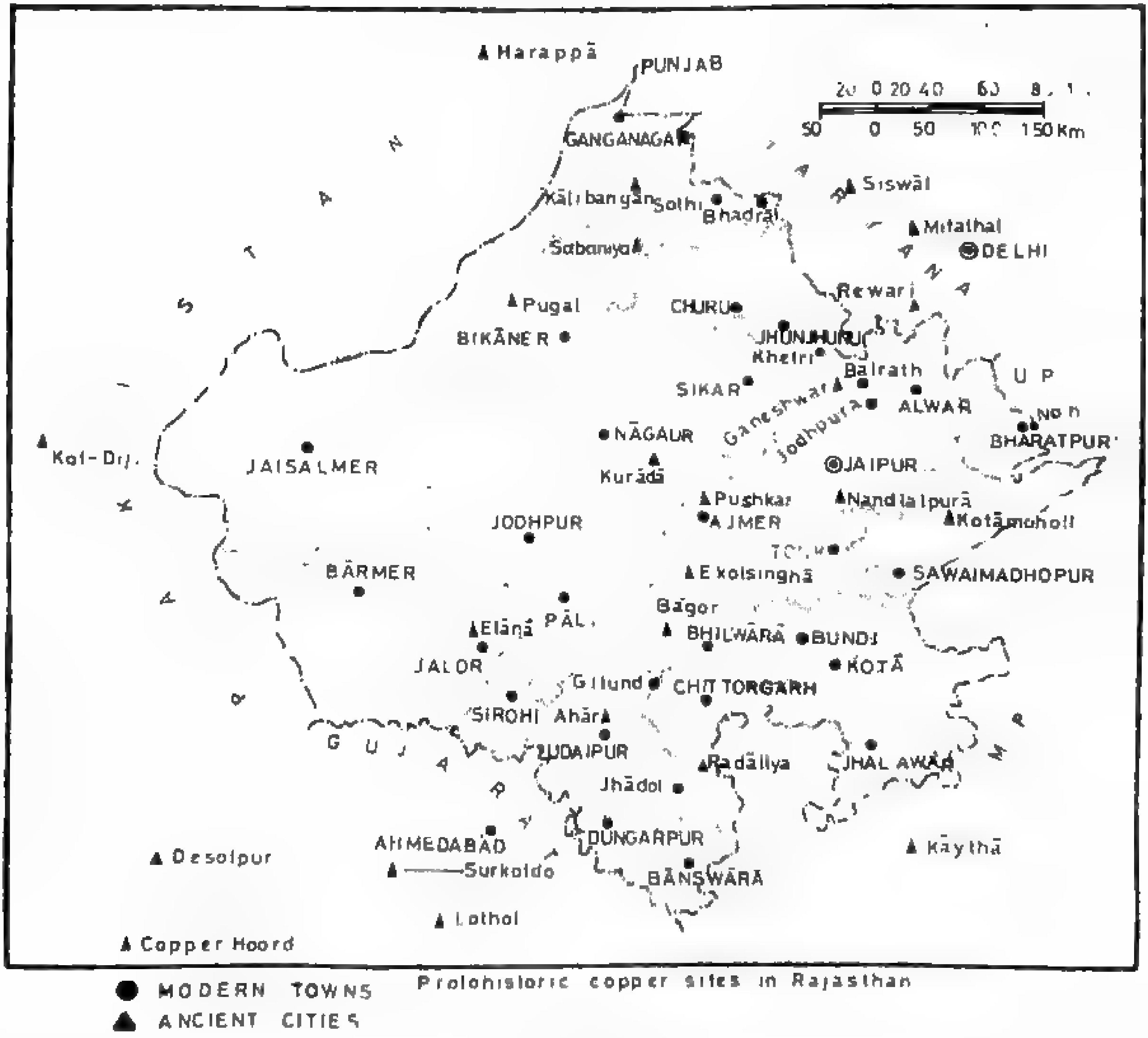
It has been put forward by some scholars in the recent years that the first agricultural communities developed in wooded foot hills. C.O. Sauer has put forward that in the wooded grounds, the "primitive cultivators could readily open spaces for planting by deadening trees".[6] As we shall see in some parts of north-eastern India evidences of 'Jhum' cultivation has been obtained in neolithic context. Sauer proclaims that the "primitive cultivators could not establish themselves in large river valleys subject to lengthly floods and requiring protective dams, drainage or irrigation".[7] G.W. Dimbleby also subscribes to this view.[8] But neither the method of deadening trees nor that of cutting them down, nor that of setting fire to them (a method of 'slash and burn', often applied in 'Jhum' cultivation) is truly efficacious for clearing land for cultivation. First, these methods would not suffice to remove the stumps and roots of trees. This task

has to be handled separately subsequent to the felling of trees. Deep digging would be required here for which stone and even copper tools would serve only limited purpose. Thus, the whole operation involves a lot of difficulties for the early farmers with their stone equipments. In fact, the task was difficult even for the chalcolithic people, as we shall see, in the ecological setting of deep, thick forests. Thus the above operations can achieve only small clearings. Agriculture, therefore, would be limited to very small-scale subsistence level, which would have sufficed for the minimal populations staying in small clusters in an area in the early days. However, largescale development in the agricultural economy would not be possible in these circumstances. For this, wide alluvial tracts in river valleys that have sparse vegetation are most suitable.

By the third millennium B.C., the primitive farmer had much advanced his mode of subsistence and was ready to face the many problems posed by nature in his way of furthering the production of food. Even before the mature urban civilization sprang up in the valley of the Indus, attempts were being made to colonise river valleys in Baluchistan and Sind, where, the early farmers felt, more advantages could be obtained with regard to farming. All the great ancient civilizations had flourished in the great river valleys, the Egyptian in the Nile Valley, the Sumer Mesopotamian in the Tigris-Euphrates, and the Harappan in the Indus Valley.

Before passing on to the discussion of how agriculture began first in the Indian sub-continent, we must note the major crops and plants that were cultivated in the Indian subcontinent in protohistoric times, as shown by archaeobotanical evidences. Here, we must note the different types of evidences that are accepted by archaeobotanists as indicating cultivation or presence of the plant in prehistoric contexts. Firstly, carbonised spikelets or kernels, seeds or fruits were often recovered at excavated sites. Secondly,

RAJASTHAN



Protohistoric copper sites in Rajasthan

MAP-IX

evidences are also forthcoming in the form of impressions of spikelets or straw or grain on pottery and miscellaneous clay-lumps.[9] Besides these, pollen diagrams of pollen spectra obtained from the soil sticking to implements or pollen analysis of sediments in an archaeological excavation also offer informations regarding the plant economy practised in the past.[10]

Besides these evidences of plant-remains or impressions of plant, we have other incidental evidences like the ancient cultivation field at kalibangan in Rajasthan where furrow-marks were observed.[11] Objects generally associated with an agricultural economy are the big storage jars presumably utilised for storing grains, stone equipments like querns, mullers and rubbers for preparing flour or paste from grains. Structures like the big granaries at Harappa and Mohenjo-daro indicate a huge supply of crops at these cities. Moreover, evidences of irrigation at some Nal and Amris sites are very interesting. W.A. Fairservis has noted construction of dams in some river valleys like the Baran Nai Valley and the Hab river valley in Baluchistan which also provide food for thought in these directions although they are not always substantiated by findings of plant evidences at all these sites.[12] The literary evidences from the Vedic texts furnish us with a lot of information regarding the plant economy in north India from C 1500 B.C. to the sixth century B.C.

I

CULTIVATED CROPS

CEREALS : Among the cereal grains that were cultivated by the prehistoric people in the Indian sub-continent around the third millennium B.C., wheat was one of the most important food crops. Rice was another important food crop. Barley and millet are other cereals, evidences of which being cultivated have been obtained from severals sites. Sir Joseph Hutoninson has categorised the crop plants that are known to have been cultivated in ancient India into three groups.

RICE (ORYZA SATIVA)

Oryza Sativa (Rice) is the main item of the first group of crops which have its wild relatives in India, and the species of this group can be assumed to have been domesticated locally.[13] It is a summer crop. The common (Asian) rice was domesticated in the area between north India and the Pacific coast adjoining Vietnam and China. According to T.T change, rice cultivation began when the hunting, fishing and food-gathering inhabitants near the rivers and along the foot hills dropped seeds into lowlying fields. As rice-culture expanded from the naturally flooded areas into fringe areas human and natural selection came into force and, more and more, the extension of its culture by man and persistent selection within a geographic region brought about the recognizable races of rice. Wild rice cultivators gradually lost their primitive characteristics and a thrifty and productive plant type evolved.[14]

More precisely, the Oryza Sativa evolved from an annual progenitor over a broad belt that extended from the Ganges plains below the foot-hills of the Himalyas, across Burma, nothern Thailand, and Laos to North Vietnam and south China. Domestication could have occurred independently and concurrently at many sites inside or bordering this belt.[15] The earliest evidence for the occurrence of rice *(oryza sativa)* come from the neolithic site of Koldihwa in the Ganges-Vindhya region.[16]

WHEAT (TRITICUM SPHAEROCOCCUM)

Joseph Hutchinson places this crop into the group of crops which are related to wild species in West Asia and is known from archaeological records to have been cultivated there before the earliest records so far established in India. Barley is another inportant member of this group and wheat as well as barley had been confidently regarded as introduced[17] in the Indian context. There is sufficient archaeological evidence to show that the early cultivation of wheat began at Jericho, Bus Mordeh, Ali Kosh and Jarmo

in the West Asia and spread over to several sites of the 'Fertile Crescent.'[18] There were two primary ancestors of the modern varieties of wheat, viz., the wild einkorn and wild emmer. Wild einkorn gave rise to a cultivated diploid einkorn *(Triticum monococcum)*.[19] The origin of this variety is supposed to have taken place in the highland borders of Asia Minor.[20] The wild emmer gave rise to the cultivated form of *Triticum dicoccum*[21] which was a better variety, a tetraploid, available to neolithic farmers, and originating in Syria and Palestine.[22]

However, as Vishnu-Mittre points out, the variety of wheat in ancient India, commonly found at most of the sites and is even today basically adapted to north-Western India was the hexaploid *Triticum Sphaerococcum*. This was the resultant form of a cross-breeding of a *Triticum dicoccum* and a wild species of Aegilops which is reported to occur in Kashmir as well as in Afghanistan.[23] Lorenzo constantini has reported the domesticated Wheat species from neolithic Mehrgarh to be *Triticum sphaerococcum*.[24] K.L. Mehra and R.K. Arora suggest that the wheats of western Asia were perhaps not suited to the agro-climatic conditions of the area of Harappan civilisation, and locally available *Triticum sphaerococcum* was thus used. They also point out that this hexaploid wheat evolved in the north-Western parts of Pakistan and adjoining Afghanistan.[25] Thus the thoery of Hutchinson that wheat was introduced into the Indian subcontinent has to be reconsidered .

BARLEY (HORDEUM VULGARE)

Barely belongs to the second group of crops mentioned by sir J. Hutchinson which were introduced into Indian subcontinent from West Asia.[26] Together with wheat, barley is recorded to have been the oldest crop coming from Iran and Anatolia around the C 7000 B.C.[27] Constantini reports the presence of naked six-rowed barley at the aceramic neolithic levels at Mehrgarh.[28] This variety has a parallel in the barley variety from archaeological deposits in

southern Turkmenia, designated by Soviet researchers as *Hordeum Sphaerococcum*, clearly referring to the wheat taxon Triticum sphaerococcum.[29] The barely from Mohenjo-daro is identified as the *H. Vulgare* Var. *nudum*, i.e., naked barely.[30] From Harappa the *Hordeum Vulgare* Var. *hexastichum* is reported.[31] i.e. the six-rowed barely. From Atranjikhera also the six-rowed hulled *Hordeum Vulgare* L. has been reported.[32]

MILLETS

This is a wide term which is used to denote a number of cereals of the same sub-species, for example.

Eleusine coracana	:	Finger Millet ; Ragi.
Elusine indica	:	Wild ragi.
Sorghum bicolor	:	Sorghum ; Jowar.
Pennisetum typhoideum	:	Pearl millet ; bajra.
Panicum milliaceum	:	Italian millet.
Paspalum	:	do ;
Scrobiculatam	:	Kodon.[33]

As to their origin, Hutchinson places then on the group of cereals which have their relatives in Africa and states that the botanical evidence suggests that they were introduced into India, although there is not much archaeological evidence to corroborate the introduction of millets in this sub-continent from Africa.[34] G.L. Possehl points out that the presence of these cereals of undoubted African origin[35] in the protohistoric context in the Indian subcontinent is very significant.[36] He goes on to relate that since an exhaustive search of the archaeological literature on south west Asia and Iran has produced no record of any of these plants in those regions prior to late historical times, except an old and possible unreliable report of sorghum husks from the predynastic cemetery of Armant, therefore we can rule out the possibility that these crops reached our sub-continent through the indirect over-land route, moving from the Nile Valley, across south-west Asia and on to the Iranian Plateau into India.[37] He points out that the only other alternative is a more-or-

less direct connection across the Indian ocean and the Arabian sea.[38] In this connection, he mentions the brisk maritime commerce that existed between India and Mesopotamia in the second half of the third millennium B.C. and suggests that this maritime activity of the protohistoric times might have been considerably larger in scope than the historical record presently indicates, and might have embraced the African coast too. He also points out that the absence of archaeological artifacts indicating such contacts may have escaped discovery or notice in the Near East or South Asia.[39] In this context, he mentions the few vaguely "Egyptian Looking" heardrests in South India which were discovered in the sequence belonging to the second millennium B.C.[40] Earlier F.R. Allchin had asserted that the millets were intorduced into Peninsular India during the second millennium B.C. and refers to the same pottery head-rests in graves from Karnataka[41] as slight indications of cultural influences which may be broadly called Egyptian and also mentions that the maritime expedition of Queen Hatshepsut to Punt brought back plants and animals from that country. The identification of Punt is not definite but Allchin points out that this may suggest that similar expeditions may have reached southern India, carrying crop plants among the merchandise.[42]

The millets, viz., the jowar, bajra or ragi, are noted to have been present at several protohistoric sites, Pirak, Ahar, Rangpur, Daimabad, Inamgaon and Hallur. G.L. Possehl suggests that as long as wheat and barley were the only cereals to be cultivated in the Western part of the sub-continent in the Harappan context, the cycle of seasonal maturation of these plants allowed the farmer-pastoralists to practice a seasonal migration balancing agricultural and herding activities.[43] However, once the millets were introduced settled agriculture became the mode of the day, for these plants were adopted to the summer monsoon conditions and there was no room for moving away from

cultivation fields in summer-time. The pastoralists also simply settled down for at least a part of the year.[44] Moreover, it is quite obvious that the straw of the millets provided more fodder for the domestic herds. Interestingly, one of the many varieties of millets, the Kodon or Paspalum scrobiculatum is said to have its origin in India.[45] Vishnu-Mittre reports its presence at Hallur and probable presence at Ahar.[46]

LEGUMES

A variety of legumes, comprising grams, lentils and peas were cultivated and eaten by the protohistoric people in our sub-continent. Among the peas the variety *Pisum arvense* occurred at Harappa[47] and Chanhu-daro[48] in a context between C 2400 and C 1750 B.C. It is an winter crop of West Asian origin. Its occasional presence in some of the chalcolithic sites in Madhya Pradesh and neolithic site in Bihar[49] suggests that the crop was adopted well in the Indian ecological situations.

The chick-pea or *cicer arietinum* is also a winter crop of West Asiatic origin.[50] It was recorded at the Early Bronze Age deposits at Jericho (C 3200 B.C.).[51] Linguistic evidence for the cultivation of the *cicer arietinum* species in Egypt goes back to about C 1788 B.C.[52] Vavilov regarded India to be one of the centres of origin for chick pea,[53] however, the earliest record of its presence is at Atranjikhera about the first half of the second millennium B.C.[54]

Grams of the *phaseolus* spp. are summer crops of Indian origin.[55] The two varieties of the phaseolus, viz., *phaseolus mungo* Roxb. and *phaseolus aureus* Roxb. are noted to have been present at some of the chalcolithic sites in central India and a neolithic site in South India. The last site, Paiyampalli, in Tamilnadu, is dated around C 640 B.C.[56] Vavilov suggested that the original homeland of the *phaseolus aureus* Roxb. or mudga pulse was in India where it seems to have been first domesticated, and from where it spread to other countries. Regions between Afghanistan and Tadjikistan and Uzbekistan have been proposed by Vavilov

to be secondary homes.[57] The horse gram, *Dolichos lablab* or *Dolichos biflorus* is also a summer crop, said to be of Indian origin.[58] This plant is recorded to have been thriving at the south Indian neolithic sites like Paiyampalli and Tekkalkota in Tamil Nadu and Karnataka, respectively.[59]. It appears, from the above evidences, that gram was especially common in the peninsular India.

The lentils that occurred commonly at protohistoric sites in this sub-continent are the grass pea or *Lathyrus sativas* and the Lens culinaris. Both are winter crops of West Asian origin.[60] *Lens culinaris* is recorded to have been recovered from the neolithic sites in Hungary, Switzerland and Germany. In North Greece the plant is said to have occurred in neolithic deposits dating around C 6220± 150 B.C. It has also been recovered from the predynastic tombs in Egypt and from archaeological site in the former U.S.S.R.[61] It was also cultivated during the early agricultural and animal husbandry periods at Tepe Sabz in Iran.[62] In India its presence has been recorded at the Central Indian chalcolithic sites of Navdatoli and Maheshwar.[63] The earliest occurrence of *Lathyrus sativas* is recorded at neolithic Chirand in Bihar.[64] It also occurred at Atranjikhera (C 2000 - 1500 B.C.).[65]

OIL SEEDS

Of all the cultivated oil-seeds, sesame or *sesamum indicum* was perhaps the most important in the protohistory of the subcontinent. Although its botanical remains have been recovered as yet only from Harappa,[66] the several references made to it in the Vedic texts,[67] especially in association with religious rites, indicate that the oil-seed was quite familiar and important in atleast the Vedic age. It is a summer crop of African origin and is mainly a crop grown in the peninsular India at present.[68]

Among other oil-seeds, the mustard (*Brassica Juncea*) is reported from Chanhu-daro.[69] It is a winter crop of Indian origin.[70] Others like linseed (*Linum usitissium*) and

myrobalan (*Phyllanthus emblica*) come from Navdatoli and Maheswar.[71] The linseed is an winter crop of west Asiatic origin.[72]

FIBRES

Cotton, *Gossypium* sp. is a perennial crop of Indian origin. Hutchinson and Santhanam mention that the four cultivated species of cotton certainly represent at least four seperate domestications. They also suggest that the major distinct races of *Gossypium arboreum* may have arisen in the wild and been seperately domesticated. *Gossypium*, originally a perennial crop, became an annual one on domestication.[73] Cotton is known from Mohenjo-daro[74] and Harrapa.[75] At the chalcolithic site of Nevasa in Maharashtra A.N. Gulati reported the discovery of a nep of cotton fibres attached to a silk thread.[76] The earliest presence however, was recorded at Mehrgarth.[77]

Of silk the only archaeological instance so far has come from the above-mentioned example at Nevasa.[78]

An instance of flax, Linum usitatissimum, used as fibre comes from the chalcolithic site of chandoli in Central India.[79]

K.A. Chowdhury and G.M. Buth report that fibres of urticaceous plants were used by the P G Ware people at Atranjkhera (C 1200 - C 600 B.C.).[80]

FRUITS

Of all the different fruits the archaeobotanical indications for the familiarity of protohistoric people with date palms in the Indian subcontinent is quite clear. Seeds of date palm were recovered at Mohenjo-daro.[81] Matting impressions of the date-palm were found at the neolithic site of Tekkalkota in south India and at Utnur the charcoal of date palm has been obtained.[82] Carbonised seed of date comes from Inamgaon in Maharashtra.[83] Sumerian inscriptions mention Dilmun and Magan in the Persian Gulf as famous for date. It appears that the fruit was introduced into India from West Asia.[84]

A few seeds of melon were noted at Harappa.[85]

Carbonised stones of the *Zizyphus* spp. or 'ber' were obtained from Navdatoli and Inamgaon in central and Western India, respectively. The fruit is perhaps a native of India.[86]

As we find, the basic complex of plant resources that were tapped by the early neolithic man systematically, included grasses cultivated for grain, legumes for protein and fat, and usually some oil-seeds and perhaps fibre plants. The plants that became the cultigens were either annuals to begin with or were converted to annuals by selection.

II

EARLY EVIDENCE FOR AGRICULTURE

Accordingly to C.O. Sauer there were three centres of seed domestication in the old world, viz., one lay in North China including the loess lands ; the second began in Western India or Indian sub-continent and extended to the eastern Mediterranean ; and the third was in Ethiopia.[87] By the middle of the neolithic times these areas were no longer dependent on fish and other water or stream-side animals, but acquired plants suited for balanced vegetarian diet. Sauer holds that early cultivations first began in small valleys and their adjacent slopes, in mixed and varied vegetation.[88] Sauer also points out that the earliest settlements took place on loess because it was well drained, fertile and wooded and the soil was easy to dig. In the Indian subcontinent, the light, transported type of soil, i.e., the alluvial soil near the smaller river plains which were rather thinly covered by vegetation in the Baluchistan, would provide the best situation for early farming in the neolithic times. In the Central Ganges Vindhyan region too, the alluvial soil in small clearings near small river valleys or ox-bow lakes, as in the case of Sarai Nahar Rai, provided favourable conditions for incipient agriculture. In this latter region, the removal of tree trunks and brush did not become necessary, for cultivation

was carried on in patches and it was not until later, when ploughing demanded wellcleared areas for making of furrows, that it was necessary to fell the trees.

During the neolithic times the surface of the soil was loosened by primitive spade or hoe, made perhaps of wood and stone. It was more often a pick than a transverse blade. Since small seeded things were grown, there was no need for deep working that root crops required. The small seeds needed to be lightly covered. Complete tillage of a field and broad-casting or drilling came probably with the later use of a plough. Harvest required no special tools. The ripe seed-heads were broken off or pulled. Sickles of sharpened stones set in wood are an ancient tool and Sauer suggest that they were used for cutting grass. However, he doubts, that they were used in reaping of wild grass seeds. For it is the nature of wild grass seeds for the mature axis and rachis to be brittle and shatter, scattering its seeds on the ground. One of the principal changes by domestication has been to select seeds of non-shattering quality. Therefore, primitive harvesting required seed-beaters and collecting baskets more than sickles for the use of the latter would cause loss of the ripe seed.[89] This habit of harvesting may have continued even during the early days when cereals had been domesticated and this would partly account for the occasional absence of sickle-blades in stone tool assemblages at many of the neolithic sites.

In the neolithic context therefore, we find the first farmers in the valley by the side of some river, located slightly higher than the river-plain level, where the ravages of flood would not affect the small-scale cultivation of plants in small clearings in the lightly wooded hilly tracts.

THE NORTH-WEST :

It was around the early sixth millennium B.C. that the first farming activities were begun in Baluchistan on the boarders of the Indus in the Kachi Plain at the early site of

Mehrgarh. The Kachi plains, at the foot of the Bolan Pass, presented an excellent opportunity for carrying out rudimentary agriculture, so far as the ecological setting was concerned. The excavator, J.F. Jarrige points out that the Kachi Plain, lying between the barren ranges of inner Baluchistan, comprise of small valleys which concentrate the fertile alluvium brought by the drainage system from the hills and perennial streams and make irrigation from natural sources an easy matter on the land which had a rather thin vegetal cover.[90] The neolithic site at Mehargarh directly overlooks the Bolan river. The setting was almost close to the ideal hypothesised by Sauer.

Archaeobotanical evidences from Mehrgarh reveal that barley (*Hordeum* sp.). Wheat (*Triticum* sp.) and fruits like the Zizyphus and date palm (*phoenix dactylifera*) were used in diet by the aceramic neolithic settlers from the earliest period I levels onwards. Cotton (*Gossypium* sp.) was present in the period II context.[91] Constantini points out that the analysis of the Mehrgarh material, viz. charred seeds as well as impressions of straw and grain on mud-bricks, reveals that the barley at Mehrgarh had some characteristic which may be called 'local' Biometrical study of the impressions and charred remains indicate that the dominant type of naked barely had a short, compact spike with shortened internodes and small rounded seeds. These characteristics, constantini suggests, belong to domesticated plants. In the aceramic Neolithic (Period I) levels the presence of these features in the barley grains and impressions may indicate that the crop was being cultivated but perhaps not completely domesticated. In the following periods II and III, these features were very marked in the charred barley seeds indicating a complete domestication of this cereal.[92]

The discovery of the impressions of the wild barley and the two-row hulled (*Hordeum distichum*) barley, together comprising just 2.5 percent, and that of the six-row hulled barley (*Hordeum Vulgare*), making up another percent, and

lastly the naked six-row barley - all in the Neolithic Period, reveal a continuous process, beginning with the domestication of the wild seed-grass and further selections and breeding of different varieties and the ultimate selection of the naked six-row barley which comprised almost 91 percent of the total evidence for barley. Constantini points out that the last variety does not seem to have faced any effective competition from the other species throughout the neolithic context.[93] He also points out[94] that the naked six-row barley from Mehgarh has better parallels in the charred remains from archaeological deposits in southern Turkmenia which has been identified by Soviet researchers, especially M.G. Tumangan, as *Hordeum sphaerococcum*, referring to the wheat taxon *Triticum sphaerococcum* ,[95] rather than the naked six-row barley, H. Vulgare nudum, from Ali Kosh, Hacilar and Beidha in West Asia. The southern Turkmenia deposits have been dated as early as at least (4000 B.C.).[96] Constantini also points out that the sphaerococcid form of naked barley was widely distributed in an area including Armenia, the Caucasus, and southern Turkmenia.[97] In view of this very early occurrence of the barley, of different varieties, hulled and naked in a context dated to the seventh and sixth millennia, we have to agree with C.O. Sauer who points out that 'barley is certainly of ancient cultivation in India' and assert that the argument of Elisabeth Schiemann, may place the origin of the crop nearby, probably to the north-east of the sub-continent.[98] The Mehrgarh evidence, therefore, indicate a necessity to open the question of origin of barley again.

As to wheat, the charred remains and impressions reveal the presence of both hulled and naked varieties from the oldest deposits in the aceramic Neolithic context. However, the naked variety was present in very modest percentages as evidences indicate.[99] In the period I the hulled wheats *Triticum monococcum* and *Triticum dicoccum* occur and continue to be present in all the succeeding

periods upto period VII[100] contemporary to the mature Harappan times. The naked wheat, which can be referred to as *Triticum durum* is present in proportions of less than one percent in the aceramic Neolithic Period I, where its presence is evident from impressions only.[101] The naked wheat increases in frequency in period II marked by both impressions and charred seeds. It increases dramatically in frequency in period III[102] at the beginning of the fourth millennium B.C. It has also been noted that the tetraploid *Triticum durum* was characterised by small-seeded forms and a gradual transformation into the hexaploid form Triticum Sphaeorococcum is noted in the succeeding periods, as morphological and biometrical characteristics show.[103] We shall follow up further developments in the wheat cultivated at Mehrgarh in the succeeding times in the relevant context.

Besides these cereals, the diet of the neolithic settlers at Mehrgarh included fruits like the Zizyphus or ber, the stones of which have been found in all the periods. Two stones from the fruit of date palm have also been found in the levels of periods I and II. However, although the presence of the Zizyphus is quite natural in the eco-system pertaining to the Kachi Plains, Constantini finds the presence of the date palm quite contrary to the nature of that system.[104] Date palm, a plant of West Asiatic origin may have been introduced into the region as early as the seventh-sixth millennium. We shall see that the fruit occurred commonly at Mohenjo-daro.[105]

Most interesting is the recovery of cotton seeds (Gossypium sp.) next to a compartmented building of Period II. As Constantini points out, at Mehrgarh the evidence for cotton furnishes the earliest occurrence of this taxon. He suggests that further research, including study of the material from other sites in the same region, may throw more light on the question of the origin of the Gossypium Sp. and its presence at Mehrgarh in the early ceramic neolithic context.[106] Further excavations in the region are required for

a correct evaluation of the evolution of farming cultures in the region.

The aceramic community lived in large brick-built rectangular buildings which were symmetrically divided into a number of rooms. Some of the buildings may have been store-houses, as evident from the absence of doors.[107] The upper levels of the aceramic neolithic phase (Period IIA) reveal the presence of such multi-roomed units in increasing numbers which were seperated by open spaces. J.F. Jarrige has pointed out that at least three such compartmented buildings may have been used as 'granary' as indicated by several elements. The best preserved of these buildings yielded an elephant tusk, grooved by artisans and seeds of barley (*Hordeum Sphaerococcum*).[108] This species of barley, according to constantini, grows only on irrigated fields.[109] This may be indicative of an important change and improvement in farming techniques. Moreover, the recovery of a set of complete stone sickle blades and grinding stone alongwith this barley which according to constantini, grows only on irrigated fields, all coming from Period II levels,[110] indicate that the agricultural economy had been taken up in earnest. As we have already seen in the previous chapter, these neolithic farming folks of Mehrgarh also had a busy herding economy with stocks of domestic sheep, goat, cattle, buffalo, pig and onager.[111] The picture that emerges is of a highly efficient and organised farming-herding society by the standards of the neolithic time on the banks of the Bolan.

Mehrgarh therefore provides us with an excellent picture of a transformation from hunting — gathering economy to a farming-herding stage through domestication of plants and animals in the neolithic context as early as the seventh-sixth millennium B.C. (Some radio-carbon dates are available,viz., 5182± 80 B.C., 5378± 290 B.C., 6743± 250 B.C., 7716± 120 B.C. and even 11790± 120 B.C.).[112]

J.F. Jarrige points out that parallels to the Mehrgarh aceramic Neolithic cultural context exist in some early

villages of the Zagros piedmont, where a transition from hunting-gathering to domestication of plants took place. He suggests that a certain degree of inter-relation and information existed between the two regions in those times, despite the vast geographical distance existing between the two regions. He proposes that such inter-relations of give-and-take existed throughout the regions between Mesopotamia, the Indus, the Karakum desert and the coast of the Persian Gulf.[113] However, he also points out that this did not imply that the kachi plain was a marginal zone. Rather, it was a part of a large-range communication net-work well-connected with Central Asia and the Iranian Plateau.[114]

In view of the archaeobotanical evidences related above, it appears that the region around Mehrgarh indeed saw the rise of a farming culture on an independent basis. It may have been one of the many nuclear centres where local domestication and cultivation of wheat and barley evolved by about the sixth millennium B.C. It may also have been that the practice of wheat and barley cultivation was handed over to the Harappans from their precursors around Mehrgarh. Thus wheat and barley seem to have been the cereals common to the north-western region of the subcontinent right from the early neolithic times. It also appears that plants were cultivated, selected and modified by man long before pottery was made, as the archaeobotanical evidence from the aceramic Neolithic levels at this site reveals. C.O. Sauer has also asserted this theory.[115]

Unfortunately, this excellent data, on the study of agriculture in the neolithic context coming from Mehrgarh, is not followed by similar evidences from the other neolithic sites, belonging to slightly later dates, in this region.

To the north of Mehrgarh, in the plains near the Zarghun mountains, on the banks of the Hannah river in the Quetta valley lies the neolithic site of Kili Ghul Mohammad, where a pre-ceramic Neolithic occupation was revealed. Here

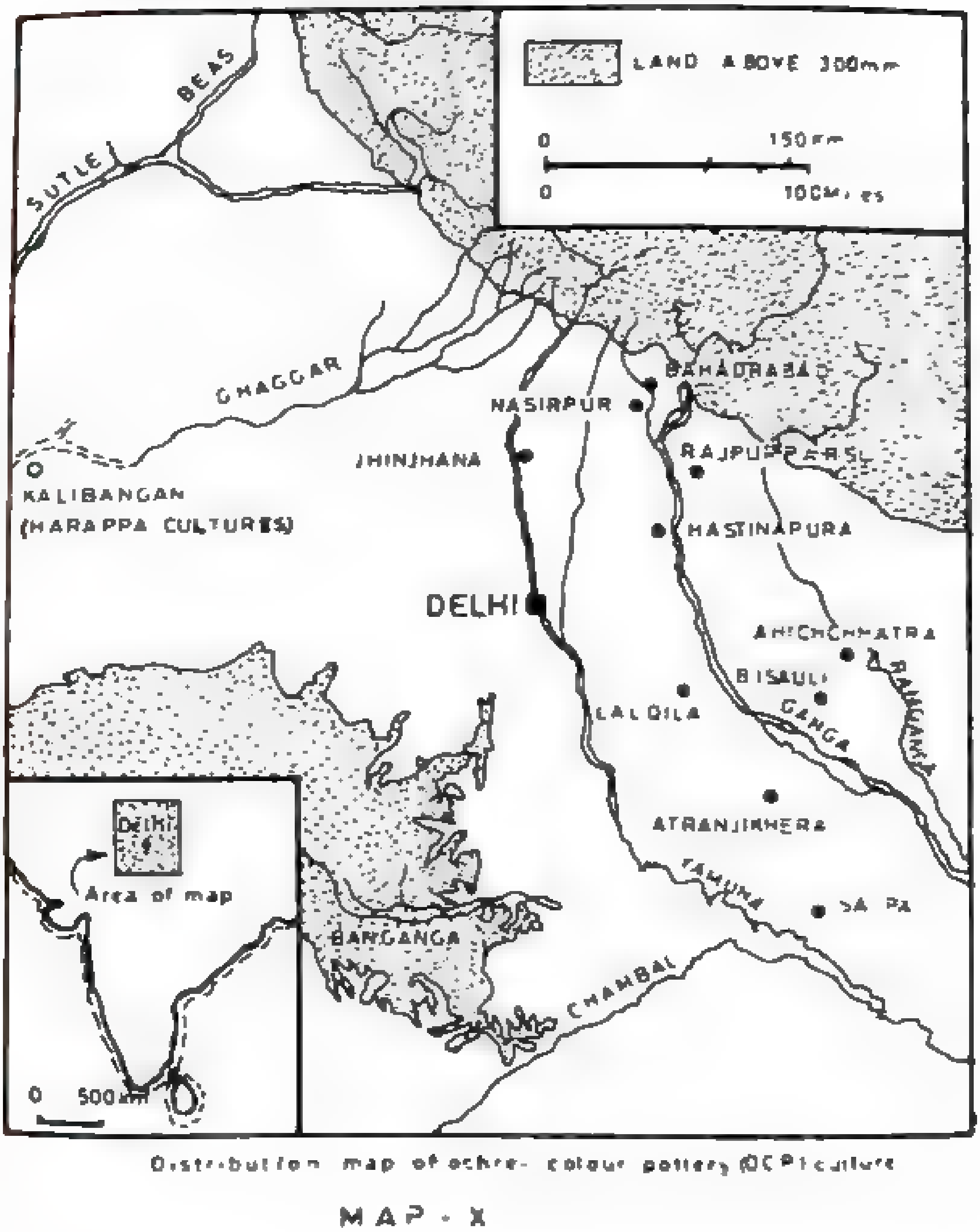
lived semi-nomadic folks who had domesticated goats, sheep and cattle. Towards the end of this period they began to live in huts of pise and wattle-and-daub. The presence of a few sickle blades suggests that the people may have cultivated a cereal crop.[116] Ground stone equipments like milling stones and pestles were also recovered[117] which may have been used to prepare food from cereal grains. Stone saddle-querns, rubbers and mullers were also recovered from some sites like Gumla.[118] Two radio-carbon dates are available from the upper-most levels, viz., (4400 B.C. and C 4100 B.C.) pushing this period I to the sixth-fifth millennium time-range.[119] The period II levels at this site, which may now be placed in the fifth-fourth millennium, reveal a settlement of fully sedentary folks with mud-brick houses and a hand-made pottery. This phase is widely represented in Zhob and Loralai regions at Periano Ghundai, Dabar Kot, Rana Ghundai I(a) and sur Jangal, as also in Kalat in the Surab region at Anjira I, Siah Damb, and in the Gomal Plains at Gumla.[120]

At these sites, we have already noted in Chapter I, evidences reveal that the practice of herding domestic stocks was quite in vogue. In the absence of direct archaeobotanical evidenced we cannot make any definite conclusions as to the nature of farming practised by the neolithic folks at these sites around the fourth millennium B.C. However, indirect evidences reflect an approach being made towards a sedentary way of life towards the latter half of this millennium which may indicate the rise of a farming economy.

W.A. Fairservis has described the stages of cultural evolution in Baluchistan. He puts that at least as early as 3500 B.C. 'A semi-nomadic people who had domesticated sheep and/or goats and possibly cattle and certainly grew some crops, were moving about in northern and central Baluchistan.........'. This comprised the stage I of the story of the socio-economic evolution.[121]

The second stage is evident in the Quetta Valley, Surab

CHALCOLITHIC CULTURES



Distribution map of ochre- colour pottery (OCP) culture

MAP - X

and Loralai where a gradual evolution from semi-nomadism to permanent village life was noted. Fairservis attributes the development of such technology as wheel-made pottery, copper smelting, stone-bead cutting, rushing and weaving to this stage.[122] Obviously, this stage, therefore ushers in the copper-bronze age in Baluchistan. But as far as our evidence from Mehrgarh is concerned, we find that a settled life had already begun here in the stage I of Fairservis, i.e., the Neolithic stage. The evidences from the other early neolithic settlements mentioned above also show that sedentarism was indeed setting in around the fourth-third millennia B.C., even before the copper-bronze Age dawned on the scene. As Fairservis himself assumed, some sort of crop-farming, indeed, appears to have been practised by the people in these times. The experience at Mehrgarh could not have remained a totally isolated one. However, further and more extensive excavations are necessary for a correct understanding of the situation.

Between the beginning and the middle of the fourth millennium B.C.[123] the region of southern Afghanistan saw the rise of human settlements. Mundigak on the Kushk-i-Nakhud Rud, a now-dry tributary of the Arghandab river which itself is one of the major tributaries of the Helmand river,[124] gave shelter to a group of semi-nomadic people who had a ceramic,[125] lithic tools like the milling stone,[126] bone tools[127] and had domestic herds of sheep, goat, cattle ass and dog.[128] From period I_2 onwards we note the arrival of copper metallurgy.[129] Thus Mundigak witnessed a chalcolithic culture from this time onwards. At DehMorasi Ghundai a neolithic settlement occured around the fourth millennium B.C. (A single radio-carbon sample available for period II B gives the date of 3200 B.C.).[130] A few stone artifacts and ceramics are the only remains. No structural debris were found, as at Mundigak period I_2.[131] However, among the stone tools, milling stones, pestles and a few stone hoes[132] were recovered from the periods I-II.[133] The

latter may belong more difinitely to period II, whence evidence of agriculture comes.[134] Period II also was the emergence of copper metallurgy.[135] The settlement at said Qala Tepe is still later in point of time (Period I = 2110 B.C.).[136] Metal artifacts begin to occur from the end of period II onwards.[137] No evidence of any importance as to the practice of agriculture are available from period I levels.

It appears that while the regions in Baluchistan were progressing towards the higher economic stage of agriculture around fifth to fourth millennia, southern Afghanistan, at least as exemplified at the above three sites, was yet to experience a settled human occupation. Mundigak prior to the chalcolithic stage was a temporary site for seminomadic hunters gatherers. As J. G. Shaffer points out, to date in Afghanistan not one sedentary farming village of the neolithic context has been located.[137] However, he also states that the lack of evidence is not surprising considering the limited sample size and the current state of prehistoric research in Afghanistan. He suggests correctly that further researches and excavations may open up new sites and a new horizon in the cultural scene of Afghanistan.[138] At present, however, we find that no farming activities are attested here previous to the Copper-Bronze Age.

THE NORTHERN NEOLITHIC

Around the third millennium B.C. neolithic settlements were sprouting up in Kashmir. At Burzahom, we have already seen in the previous chapter, neolithic folks in period I lived in dwelling pits. The settlement of Burzahom, 16 Km. north-east of Srinagar, is located on the ancient Lake bed that once constituted almost the whole of Kashmir. This ancient lake bed is now locally called karewa.[139] The period II people lived in mud and mud-brick huts.[140] From this phase stone tool repertoire included harvesters, pounders, grinders, double-edged picks and perforated picks.[141] These tools may have been used in agricultural activities. However, no seeds of cereals were recovered from the purely neolithic

period I levels. R.N. Kaw points out that a stone-quern was found during excavations in one of the pit chambers of this period.[142] Evidence of some wild plants were obtained from Burzahom, viz., *Lithosperum arvense* or wild peas *Medicago denticulata, Lotus comiculatas* or lotus plant and fruit and *Ipomoca* sp.[143] It appears that these wild plants were used in the diet by the neolithic folks at Burzahom. These people were in a stage which was approaching towards a farming economy. As we have already discussed, man's experiments with wild plants led to the selection and domestication of some species, which are the common cultigens at present. The neolithic folks at Burzahom, in the third millennium B.C. were perhaps still experimenting with the wild plants and were as yet one step away from rudimentary agriculture.

The evidences from the recently excavated site of Gufkral in Kashmir, however, yielded interesting results in this direction, the excavator, A. K. Sharma points out that while it is not yet clear whether the earliest aceramic neolithic inhabitants practised agriculture or not, grains of wheat. six row barley, lentil and *masur* pulse were obtained by flotation technique. On the basis of this evidence, A. K. Sharma suggests that wheat, barley and lentil had a much greater antiquity in Kashmir than rice, which, he points out, was introduced in the period II at the site.[144] It appears, therefore, that the later neolithic phase in the Kashmir Valley saw the gradual development of an incipient farming economy. Further excavation at other sites in the Kashmir Valley may provide us with a complete picture of how this evolution took place in the neolithic context throughout the Kashmir Valley.

Evidence of contemporary developments in the Swat Valley, in Pakistan comes from sites like the Ghalighai cave, Loebanr and Bir-Kot Ghundai.[145] The earliest occupation layers at the site of Ghalighai, dated to the first half of the third millennium, yielded remains of only *celtis*.[146] Hand-made pottery and a pebble-tool industry comprise the cultural

assemblages. But from the succeeding period II, around the middle of the third Millennium B.C. a cultural change is marked. A fine wheel thrown pottery painted black-on-red and charred seeds of wheat *Triticum aestivum compactum* were recovered, the last from the earliest layers of this period.[147] At the beginning of the second millennium B. C. with the commencement of the period III, we find the arrival of barley on the scene, evident from the presence of charred seeds of *Hordeum Vulgare.* The pottery of this period has parallels in the wares and shapes represented at Burzahom neolithic.[148] From the neolithic period III of Loebanr two varieties of barley and a little wheat, along with rice, lentils (*lens culinaris*) and field pea (*pisum arvense*) have been recovered. People lived in dwelling-pits as well as wattle and daub huts.[149] Radio carbon dates suggest that this cultural tradition continued throughout the second millennium B. C. The Leobanr III sequence has parallels in Ghalighai period IV.[150] Stacul suggests that the middle of the second millennium B. C. witnessed a growth of population and new forms of stable agricultural settlements in the Swat Valley.[151] We find that the major cereals like wheat, barley and rice had been domesticated and cultivated along with lentils and legumes in this region. Interestingly enough, at Gufkral also we note the arrival of wheat, barley and lentil in the neolithic. Further excavations may provide more data to complete the picture of this 'neolithic revolution' from hunting-gathering to farming in the northern valleys of the Indian sub-continent by the second millennium B.C.

THE GANGES - VINDHYAN REGION

The Vindhays and the Ganga Valley attest to the growth of human population and the movement of people from the Epi-palaeolithic through Mesolithic to Neolithic times.[152] A number of settlements of Middle Palaeolithic in the Belan Valley and in the District Monghyr of Bihar have been discovered. A section of the Belan gives us a sequence from the Lower Palaeolithic to the Mesolithic without interruption.

Upper Palaeolithic sites have been reported in the Vindhyan region and in the Ganga Valley at Districts of Mirzapur. Allahabad and Banda.[153]

The evidences from the sites of Chopani Mando. Sarai Nahar Rai, Koldihwa and Mahagara are of special interest to us. The type-site of the Vindhyas. Chopani Mando. where a continuous sequence of cultures from the epipalaeolithic to proto neolithic has been revealed by excavation.[154] is in itself an object of interest to trace the evolution of human cultural development. But, what is of more importance to us is the picture of the mesolithic life provided by this site. Excavations have revealed that the mesolithic people here lived a semi-settled life, attested by the evidences for circular, oval huts of wattle and daub, sometimes with stone paved floors. Each of these huts, built on wooden posts. was a complete dwelling unit. A number of stone tools were obtained from the floors of the huts.[155] G.R. Sharma points out that this picture indicates sedentarism for the first time in this region. He postulates that sedentarism led to an increase in population and an altered economy by the neolithic times.[156] At Sarai Nahar Rai, in the Ganga Valley. the advanced mesolithic occupation was characterised by several huts and hearths ; a ground stone industry comprising grinding stones ; a crude, hand-made pottery ; animal bones showing existence of sheep, goat and cattle.[157] The rice of wild variety embedded in clay lumps indicate collection of wild edible grains.[158]

From this stage we pass on to the neolithic. exposed at the sites of Koldihwa and Mahagara, located on the Belan river.[159] As G.R. Sharma points out, the element of sedentarism had much advanced by the neolithic times and at Mahagara we witness the emergence of separate family-house units planned around cattle-pens.[160] The prolific use of rice-husks and chaff as pottery tempers at these sites[161] and the discovery of rice remains of the cultivated variety for Koldihwa[162] establish conclusively the cultivation of rice

from the earliest levels of the neolithic. We have already seen in the previous chapter that cattle had been domesticated in the Neolithic times at Mahagara and Koldihwa, dated to the sixth millennium B.C. Wild sheep, goat and cattle were present in this region right from the palaeolithic times.[163] And, we have already noted that wild rice was collected by the mesolithic people at Sarai Nahar Rai.

It becomes clear now that the potentially domesticable wild rice and at least the wild cattle that existed in the region prior to the neolithic times, were locally domesticated by the neolithic times around Koldihwa and Mahagara. G. R. Sharma points out that the radio-carbon dates for the pre-neolithic, 8080± 115 B.C and the Early neolithic, 6570± 210 B.C. and 5440± 240 B.C., give these evidences an enhanced importance in the matter of origin and diffusion of the cultivation of rice and domestication of cattle.[164] It appears now that such domestication took place simultaneously at many regions quite independent of any diffusionary element from outside. For, as far as is attested by the cultural assemblages at these sites in the Ganges-Vindhyan region, it appears that they developed in relative isolation from outer regions. As Shashi Asthana also points out, the evidences from these sites shows that in favourable in the same manner, remaining completely unaware of each other and developing a settled way of life, family-units and domestication of plants and animals in a pre-urban society.[165] G. R. Sharma asserts that until more coherent and conclusive evidence comes from other centres, this region in India, the Belan Valley in the Vindhyas, will remain an original, primary and nuclear centre for the beginnings of rice cultivation and the domestication of animals.[166] It should be mentioned here that the rice from Non-Nok-Tha in northern Thailand has been described to be intermidiate between use of wild and weed rice and is datable to the fourth millennium B.C.[167] The Chinese evidence of earliest occurrence of rice from Sung-tse is dated to 5480 B.P.[168]

We must note here that, as we have already seen, Mehrgarh has proven to be another such site whence the evidence for the domestication of the Zebu cattle and cultivation of barley and wheat comes from the aceramic neolithic levels onwards dated around the same time as the evidence from Koldihwa and Mahagara.

It appears that the Vindhyan plateau, with a perennial water source in the Bolan river, the Son river, with thick forests supplying wild games, a rich supply of raw materials for stone tools, and a tolerable climate of long hot summers, a fairly pleasant monsoon and a cold season, having an annual rainfall of about 965 to 1000 mm, attracted the prehistoric people and provided a rich backdrop to the drama of human cultural evolution from hunting-gathering to a subsistence farming-herding economy very early compared to most regions in our subcontinent.

EASTERN NEOLITHIC

The archaeobotanical evidences from some of the neolithic sites in Bihar, Orissa and West Bengal reveal that the dominant cereal in these regions was the rice, *oryza sativa*. Evidences come from the neolithic levels at Chirand in Bihar,[169] in district Saran, from Baidipur in Orissa[170] and from Pandu Rajar Dhibi in West Bengal.[171]

Paddy-husk impressions as well as a few examples of charred rice were recovered from the neolithic sequence at Chirand. However, charred grains of wheat, barley and pulses like moong and masoor were also recovered from this site along with rice. B.S. Verma states that while available radio-carbon dates for the neolithic phase range from 1900 B.C. to 1300 B.C.,[172] there is a possibility that the settlement may be pushed back to around the 2,000 B.C.[173] Vishnu-Mittre, who has examined the plant remains and the deposits at Chirand estimates that the age of Chirand food-grains may be placed around 3500 B.C.[174] However, it is difficult to accept this early date for Bihar neolithic.

Pandu Rajar Dhibi in the valley of river Ajay in District

Burdwan yielded pottery fragments with the impressions of husks belonging to the period I sequence which may be placed in the early second millennium B.C. These materials were scientifically analysed by Sri A.K. Pal of the Directorate of Agriculture, Govt. of West Bengal and identified as those of the cultivated paddy, Oryza Sativa L. Graminae.[175] As the excavator points out, the first neolithic inhabitants at this site appear to have been simple agricultural folks living in mud houses and having a ceramic industry and stone tool assemblage.[176]

Although the neolithic sites in Assam, in the Cachar Hills, do not yield any substantial evidence for sedentary life or farming herding economy, the site at Deojali Harding in the nort Cachar hills, yielded a sequence of neolithic culture of the 'Jhuma' cultivators (shifting cultivation), characterised by neolithic tools, bone tools and pottery.[177] The neolithic man here lived in mud walled houses and used such stone tools as querns or milling trough and mullers.[178] In the absence of archaeobotanical evidences nothing can be concluded about the state of economy, or whether farming economy had at all evolved properly in the neolithic context in these regions. The lack of habitational remains in the north eastern hilly regions imply a low density of settled population and a cultural lacuna of some sort due to geographical factors like heavy rainfall and eroding soil. But there are evidences of Jhum or shifting cultivation here which might have resulted into a shifting population leading to little accumulation of occupational debris. Slash and burn Jhum method is still a part of tribal technique of small scale farming in the region. The importance of this technique and corresponding farming cannot be ignored in adverse geographical conditions as excellent adaptation of technology for sustaining life. Further excavations and discoveries of sedentary settlements are required for a correct understanding of the evolution of agriculture in this context. However, barring these north-eastern most regions, incipient cereal

agriculture emerged in the neolithic context in the eastern part of our sub-continent, as our evidences suggests.

SOUTHERN NEOLITHIC

The problem of transition from the stage of advanced hunting to that of food producing in South India is aggravated by the lack of antecedental phases and a continuity of occupation at most of the excavated sites, unlike the excavated neolithic sites in the north-western, northern, central or some of the eastern regions. The evidences for plant economy that are available at the South Indian neolithic sites are quite late and fall in the second millennium B.C. Most of the archaeobotanical evidences come from the later neolithic phases. At some of these sites, however, we have seen in the previous chapter, the economy of animal husbandry had already been taken up in the early phase of the neolithic. It may be assumed that full-fledged cultivation began only after the dawn of the later phase of the neolithic. As K. Paddayya points out, animal husbandry was the occupation of the neolithic folks in south India and the culture had a strong pastoral character.[179] The existence of seasonal camps of the nomadic herders emphasise this point.

From Tekkalkota in District Bellary, Karnataka, charred grains of horse gram (*Dolichos biflorus*) have been recovered from the period I levels in the cutting TKT-2. Remains of storage bins nearby attest to the storing of cultivated grains in this context. Remains of two houses with a lime-plastered mud platfrom were outlined from this level.[180] Matting impressions of date-palm plant has also been recovered from this site.[181] Such matting impressions of the date palm has also come from Kodekal, Karnataka. A pottery sherd of slipped and burnished red ware has the impressions of a twilled mat probably made of date-palm leaves.[182] A charcoal of date-palm has also come from Utnur.[183]

Paiyampalli in Tamil Nadu has yielded evidences which reveal that the neolithic settlers here cultivated cereals and pulses. Charred grains of horse gram or Khulti (*Dolichos* sp.)

and green gram or moong (*Phaseolus mungo*) have been recovered.[184] The presence of ragi of finger millet (*Eleusive coracana*) at Paiyampalli is doubtful, first, because it has not been mentioned in the report of the Archaeology - 1967-68 - A Review. Secondly Vishnu-Mittre mentions that his examination of the material sent by the excavator revealed that it was a legume.[185] The recovery of such tools and equipments as short blades of chalcedony, chert and quartz, querns, pestles,[186] mortars, pounders[187] and perforated stones used as weights of digging sticks[188] indicate full-fledged agricultural activities. By the phase B times the neolithic settlers at Paiyampalli began to prefer living in built-up huts with wodden posts and floors made of stone chips plastered with ash-mixed earth. The people possessed a grey ware which was joined by a red ware.[189]

But, by far the most interesting fact is the occurrence of the different varieties of millets at some of the neolithic site in south India. The earliest report of millet has come from the ash mound site of Kudatini. R. B. Foote had referred to the presence of straw impressions of the great millet (*Holcus Sorghum*) on the cinder lumps collected by him from the Kudatini ashmound.[190] Hallur, in District Dharwar, Karnataka, on the left bank of the river Tungabhadra, yielded charred grains of finger millet or ragi (Eleusine coracana) of both oblong and globose shapes.[191] Vishnu-Mittre points out that while the globose grains compare with *Eleusine coracana*, the oblong grains belong to *Eleusine indica* a wild relative of the *E. coracana*.[192] The neolithic context of the material, its date around C 1800 B.C., as well as the discovery of the finger millet along with a wild variety suggest that at Hallur we are face to face with an early stage of the history of finger millet in the Indian sub-continent. In fact, no other site has yielded this crop earlier. However, at Tekkalkota, the period I levels yielded evidences for the occurrence of the finger millet.[193] We have already noted that millets were a group of cereals of African origin. We

have discussed this point before. Here, we shall only make the point that at Hallur neolithic finger millet, which was later to become a common crop in the modern times, was making its first appearance in the Indian sub-continent. Lastly, we must mention at some of the south Indian neolithic sites, evidences show the presence of the Zizyphus fruit or *ber*, notably, at Kodekal[194] and Palavoy.[195]

The above survey of the evidences from the South Indian neolithic sites indicate that the crops domesticated and cultivated in this region were quite different from those in the north-western, northern and central-eastern regions. The problem of the origin of millet cultivation in neolithic South India can only be solved with further researches on probable contacts between African continent and the peninsular India. But what is of significance here that there is little evidence of a diffusion of agricultural practices from the northern regions into this region. It appears that farming economy developed in south Indian neolithic context quite independently of other cultural contexts of the Indian sub-continent. As to farming methods, it is commonly belived that the terraces formed on the granitoid hills on which most of the neolithic sites of South Indian are located, were probably utilised as farming plots. As K. Paddayya[196] points out, the present-day primitive communities like the Hill Reddis of Andhra Pradesh still use these hill-terraces as cultivation plots. Such terracing behind a stone retaining wall, would incidentally help to conserve both soil and moisture after the monsoon. The vegetation covering the terraces could be cut down with the help of stone axes and then reduced to ashes by setting it on fire. The 'jhum' mode of cultivation in which clearance of forest by fire is the important feature, is another element which is still prevalent among the tribes of some hill regions. The cleared ground could be raked up by hoes made of blunted stone axes or with digging sticks, which occur at many of the sites. Seeds could be sown by simple broadcasting or dibbling them into

holes made with digging sticks. It appears that neolithic cultivation in South India was generally restricted to these terrace-fields and never spread to the black cotton soil which is sticky and too heavy to work after rains without a plough. However, location of some sites like Hallur and T. Narsipur[197] in District Mysore, in the river valleys make it probable that at some areas, alluvial river banks were also considered suitable locations for settlements and cultivation by the farming neolithic people. K.R. Alur's examinations of faunal remains from Hallur exposed deformities or bone diseases like bone exostosis which indicate that some animals, like the cattle was put to heavy works like drawing the plough.[198] It may have been that farming people on the banks of the Tungabhadra in the neolithic times used domestic animals to plough the cultivation fields towards the end of the period.

At the end of this survey of the state of farming economy in our sub-continent in the neolithic times, we find that a general pattern of farming had evolved throughout this sub-continent. Indeed the time-range of the neolithic varies roughly from the seventh-sixth millennium to the second millennium, but by the end of the neolithic and the beginning of the chacolithic phase, we find that a common pattern of distribution and cultivation of crops had emerged. Now, we find three separate farming cultures had evolved in three regions of the Indian sub-continent, viz., the Rice Culture in the Central-Eastern region ; the wheat-barley culture in the north-west and to some extent the north ; the millet culture was confined to the southern region in the neolithic times.[199]

The first farming folks had made their appearance on the soils of the Indian sub-continent. A sedentary village life was ushered in. An increase in population, development of specialised handicrafts, increasing specialisation in agriculture and herding economy, development in architecture, beginnings of metallurgy, these features would now be dominating the scene. Our evidences from Baluchistan,

Afghanistan and the Indus Valley exibit the traces of the growth of these features beginning in the second half of the fourth and the early part of the third millennium B.C.

As we have already noted above, most of the neolithic sites of any major importance were located near perennial water sources, especially in the small river valleys. In some cases, as at Mehrgarh, the settlements overlooked major rivers. But as the farming economy took roots in Baluchistan and the Sind we find that the people began to prefer the larger river plains more and more. A shift towards the Indus plains is noted throughout the pre-Harappan-Harappan phases.

III
AGRICULTURE IN THE PRE HARAPPAN CONTEXT

Around the fourth-third millennium B.C., viz., periods VI and VII at Mehrgarh, the farming pattern remained almost the same barring same changes in the plant taxa. For example, in case of the barley the naked six-row variety which, as Constantini points out, had a close parallel in the *Hordeum sphaerococcum* from southern Turkmenia, continued to be cultivated in a great proportion as we have already noted in the previously. But in period VII (third millennium) hulled barley seem to show a modest percentage increase in comparison with the naked barley.[200] In these periods we also note an increase in the percentage of the naked six-rowed wheat *Triticum Sphaerococcum* which was evident from period V onwards.[201] As Constantini points out, the Mehrgarh evidence suggests a shift towards the cultivation of the spherococcoid form of hexaploid wheat. This, he further suggests, may indicate that in the Kachi region the conditions during the prehistoric times favoured these rounded types of grains.[202] Other most interesting facts are the appearances of oats (*Avena* sp.) in an even earlier sequence in period III levels at the beginning of the fourth millennium B.C.[203] and the occurrence of the gaps in period V levels .[204] As Constantini points out the presence

of the last species of plant is not in conformity with the natural environs at and around Mehrgarh and this fruit seems to have been introduced from outer regions. The study of the grape pips found at Mehrgarh has excluded the presence of wild grapes, confirming that grapes were introduced into the area following the development of cultivation techniques elsewhere.[205] Mehrgarh also provided the earliest record of the oat in this subcontinent.[206] From period IIB onwads copper metallurgy had made its appearance at Mehrgarh (beginning of the fifth millennium B.C.).[207] The structural evidence indicates that the storage units, noted earlier in the neolithic sequence, were very much present and were built with increasing sophistication. As earlier evidences suggest these storage units were used for storing products of various crafts as well as cereals and other crops.[208] As Jarrige points out, these evidences suggest a collective system of storage maintained over a long period of time from period IIA onwards.[209] He has given a detailed description of one such building from period IIB (chalcolithic), which is divided into ten narrow compartments, symmetrically disposed on each side of a narrow corridor.[210] As usual, this building has no door. Its use as a granary would explain the large number of barley and wheat imprints noticed in the compartments. Two very well-preserved sickles with three bladelets hafted slantwise in bitumen have also been found in one of the compartments. Outside this building a large fireplace was found to contain several hundred charred grains of wheat and barely.[211] The picture is that of an orgainsed society and economy marked by craft specialisations in the fields of ceramics, precious-stone cutting and polishing, copper metallurgy, architecture, agriculture and animal husbandry, by the beginning of the third millennium B.C. in the Kachi Plains.

The region in the upper drainage of the Kushk-i-Nakhud Rud witnessed the emergence of copper metallurgy in the middle of the fourth millennium B.C. marked in the period I_2 at Mundigak.[212] This site has yielded the remains of the domesticated wheat, *Triticum compactum* in the period II

levels[213] (C 3635 B.C.).[214] As we have already noted milling stones have come from all the occupational levels. They had a single level working surface and were perhaps used for grinding cereals.[215] Large trapezoidal hoes, retouched for hafting and having a polish resulting from use were located from the end of period I onwards until the final occupation.[216]

However, the first substantial or permanent habitational structure was encountered only in the phase 3 of period I which consisted of two pise walls.[217] The first mud-brick habitations were encountered in phases 4-5.[218] From period II (C 3635 B.C.)[219] onwards regular mud-brick houses were built on pise or remains of previous walls.[220] In period III we note an increasing density of structures.[221] The period IV at Mundigak saw the emergence of the "Epoch of the Palace".[222] The Late Mundingak III_6 and IV might have encompassed the entire third millennium B.C. (3000-2000 B.C.) [223]

At Mundigak therefore, we saw a continuous development from a village life to an urban environment from the fourth millennium B.C. At the base of this development lay the progress of the economy as indicated by the evidences for agriculture, animal husbandry, the proliferation of painted ceramics[224] and metal artifacts which included a number of luxury items from period II_3 on wards.[225]

As we move on south-east wards from Mundigak we have the sites of Deh Morasi Ghundai and Said Qala. We have already noted that primitive habitations were growing up here in the neolithic context, at Deh Morasi around the second half of the fourth millennium B.C. and at Said Qala much later. As evidences suggest these sites were rural in nature with no marked building activities. So far the reports of the Said Qala faunal and floral material are not available. But, Deh Morasi Ghundai, on the Dori river on the flood plain separating the Arghandab and Tamak rivers,[226] yielded the remains of a fodder grass *Aegilops tauschii* syn. A. *Squarossa*, and the domesticated six-row barley (*Hordeum Vulgare Var. Afghana*) on a brick from the "Shrine Complex" of period IIa.[227] A single

radiocarbon date of 3200 B.C. is available for period IIB.[228] Hence, the above evidence belongs to a time-range earlier than C 3200 B.C. Roughly, we may say, around the middle of the fourth millennium B.C. the chalcolithic people at Deh Morasi Ghundai were practising the cultivation of a domestic barley. The presence of the Aegilops species is very significant from botanical point of view. As we have already mentioned, this species is considered to be a progenitor of the cultivated *Triticum Sphaerococcum* wheat.[229] This may suggest that Deh Morasi Ghundai provides a link in the line of evolution of the cultivated variety of wheat mentioned.

The limited nature of the excavations prevented the delineation of any structures. The only architectural feature of significance found in period IIa was a small mud-brick structure associated with a ceramic female figurine, copper tube and seal, goat bone and horn and pottery. The excavator, L. Dupree interprets this structure as a "household shrine.[230] It is from this shrine that above archaeobotanical evidences were obtained. From period IIb a semi-circular mud-brick oven associated with a prepared floor and a mud-brick wall have been uncovered. Among the lithic artifacts, milling stones, pestles and a few examples of stone hoes are available in periods I-II,[231] as we have already noted above. Further excavation here may reveal more about the nature of this settlement. But at present it seems that Deh Morasi Ghundai was a village settlement inhabited by a farming and pastoral people who possessed a ceramic repertoire and a few metal pieces. It appears that around the beginning of the third millennium B.C., the region in the alluvial valleys of Arghandab, Tarnak and Dori near the city of Kandahar in south-eastern Afghanistan was witnessing the rise of an urban settlement at Mundigak with village settlements as corollaries at Said Qala and Deh Morasi Ghundai. The economies of agriculture and animal husbandry had been taken up by the people here who had passed on to the chalcolithic age around the middle of the fourth millennium B.C. The location of Mundigak in the river

valley of one of the major tributaries, i.e., the Arghandad, of the Helmand river, the only major perennial water source located between Mesopotamia and the Indus Valley, explains eloquently why people lived here for several millennia developing and enriching their culture from the Neolithic to the Bronze Age. The land around Mundigak was very fertile, although it did not cover a large area. An almost similar location of Mehrgarh had facilitated that site's development through a long peiod of time. As we have already mentioned above, around the fourth to third millennium B.C. We find that the primitive farmers were more and more settling down into the river valleys

Pre-Harappan evidences in Baluchistan around this time (early 3rd millennium B.C.) provide some interesting examples of irrigation activities, especially at some Nal and Amri cultural sites. As W.A. Fairservis points out, that the farmers of the day were capable of dealing with the demands of the land on which they lived is best proved by the presence of massive stone dams of 'Gabarbands' adjacent to their villages, particularly in southern Baluchistan and south-western Sind. These structures are of two types, storage or reservoir, and more frequently, Kach or terrace dams.[232]

An instance of ingenious irrigation attempt is noted at a late Amri site on the Upper Hab Valley in the Diwana region.[233] The Hab river here flows between high bluffs which retard the use of the river-water to irrigate the silt plain. The Amrian people, however, occupied a spot at the edge of this arid silt plain, close to the valley-wall at the back. Behind this front range of the valley wall is an extensive natural catch-basin or reservoir where the water which comes from mountainous torrents after rain fall concentrates. An examination of this wall revealed a gap in the front range through which this water comes out. The Amri people sealed this gap with a stone block dam 25 ft thick, there forming a complete reservoir. Apparently the impounded water was released to irrigation channels that ran across the silt plain, thus permitting its cultivation. The modern villagers of this region, who cultivate close to the banks

of the Hab river, till only small areas close to the banks that get the restricted supply of river water. The Amrian people, settled closer to the valley wall fixed for themselves a steady water supply from the mountainous torrents. As W.A. Fairservis points out, in an area which probaly never had more than 10 to 12 inches of rainfall throughout the year, the control of water source was of vital importance for sustenance and development of a farming-pastoral society who lead a more or less sedentary life. The constructions of the dam must have required the energy of the entire community. The dam was probably at one time about 75 ft long but is now broken on its northern end. The surface remains of the site primarily consist of structures of stone, viz., thick walls, paved floors, stairs and what appears to be drains, some less formal dwellings on the west of the site, and a fine ware painted black on a buff or reddish surface, a local variation of the Nal pottery.[234]

Fairservis points out that the natural reservoir and the subsequent dam were apparently the reasons for the existence of the site.[235] It may represent a control centre for the irrigation system.[236] The slope of the valley to the river would have expedited control of the waters caught behind the dam as they were released into irrigation canals at the head ot the slope. Small villages were probably spread out over the plain. Fairservis suggests, that the site itself was too small to have contained the population necessary to build and maintain the dam and to cultivate the large irrigated areas.[237] Excellent descriptions of ancient 'Gabarbands' at Pir Munaghera and Ahmad Band in the Saruna Valley, just above this region, are available.[238]

The Amri sites in general were located around the Lake Manchhar region near the Indus drainage area in south Baluchistan. The lake Manchhar is a shallow body of water connected to the Indus system by the Western Nara and by an outlet to the east, the Aral.[239] It is also the catch-basin for the mountain torrents that flow from the Kirthar in the West and the Lakhi hill tracts on the south. The Lake Manchchar area also recieves overspills from the Indus in the summer months.

Subsequently when the river shrinks in width it leaves a wide margin of land moistened for rabi sowing[240]. Thus the region allows a wonderful setting for cultivation of winter-grown crops. The type site Amri is located south of the Lakhi hills, just below the Lake Manchhar and juts into the Indus Valley. Some sites lay close to hot springs. Thus we see that gradually a shift was being made in settlement locations towards the southern river valleys and towards the Indus Valley itself.

The Nal sites, however, in the southern Baluchistan uplands, also yield remnants of irrigating activities. As Fairservis points out, '..... their water-control systems in the southern reaches of Baluchistan represents a triumph over the exigencies of the region'.[241] We have seen an example of building of a storage dam at the Amri site on the Hab. At the Nal site of Kohtras Buthi at the head of the Baran Nai Valley, we encounter an example of the utilisation of a 'Kach' system of irrigation. This system consists of a method of accumulating alluvial soil behind low dams which were built across the slope drainage. This system could be utilised in case of a river flowing through sloping contours.[242]

The Nal site of Kohtras Buthi is situated near the bank of the Baran river on the top of a hill which rises some 95 ft. above the river plain. On the eastern, western and northern sides the hill is steep and hence not easily accessible from the valley below. However, on the southern side there is a gentle slope. Here a series of two walls were built by setting boulders in a dry-stone fashion. It is through this wall that an entrance was made into the settlement. On the western side, the gaps in the hills are filled with massive stone walls, that is, at the foot of Kohtres Buthi two stone walls cross the gaps between the site and the adjacent hills. The alluvial soil would settle behind these dams built across the foot of the hills and this soil would provide a fertile field for cultivation.[243] These man-made walls suggest a high standard of engineering skill achieved by the Nal folks here, which were motivated by the need for an efficient water-control system and an utilisation of the local soil resources to the full.

Similar evidences come from a number of sites having Nal affinities. Aurel Stein reports such sites in Kharan, in west Kalat on the rim of the Mashkel basin, where dams made possible a Nal settlement at Toji. "Low stone dams measuring about 4 to 5 ft high and 8 ft. thick and some hundred yards or more in length were placed across nullahs that ran close to the site,"[244] enabling the silt to collect behind the dam.

South-west of the Lake Manchhar-western Nara region where the Amri sites were concentrated is the Las Bela Plain near the Arabian sea-coast. The ancient site of Balakot, sixteen Kilometres inland from the Arabian sea, off the south-eastern corner of the Las Bela Plain had been occupied by a farming-herding pre-Harappan folk around the late fourth millennium B.C. The site[245] has yielded archaeobotanical evidences comprising carbonised seeds and endocarps, casts and impressions of leaves, and stems and seeds in baked clay (pottery and bricks). G. James west's study of these materials resulted in the identification of the six-row barley *Hordeum Vulgare* among cereals and the *Zizyphus* fruit at both the pre-Harappan Balakotian levels as well as the Harappan levels. Four leguminous taxa called 'vetches' by West could not be identified to the species of genus level.[246] Subsequently, Margaret, B. Mckean has identified the cotton *(Gossypium sp.)* and gourds (*Cucurbitaceae*) among the Balakotian and Harappan pollen samples from the site. The presence of the pollens of these economic crops which also indicate the use of irrigation and agricultural fields is very significant.[247] Mckean states that a gamut of plant economic strategies is evidenced from collection of local wild food stuffs to small garden cultivation and field agriculture dependent on irrigation/ inundation controls.[248] The plant economy at Balakot includes both winter or rabi crops like barley and pulses or 'vetches' and summer crops like cotton, indicating a double cropping pattern or intensive agriculture. While most of the crops identified may be assumed to have supplied local economic needs, the cotton cultivation at Balakot suggests the

site's importance on an inter-regional level.[249] At Balakot therefore, we get a confirmation of the evidence of cotton having been cultivated early that we had obtained from Mehrgarh period II. As we shall see the Harappan agricultural economy was indeed enriched by the presence of this crop in the Mature Harappan days also. The Khurkhera Plain where Balakot is situated is watered by the Windar River, which when in flood during the monsoons, deposits masses of sediment over the plain. During good years these floods permit agriculture without the use of irrigaion.[250] But the presence of both summer and winter crops suggest that some sort of irrigation was taken recourse to, for example, channels may have been dug from the river banks to divert water from the river into the nearby cultivation fields.

Further north from this region around the upstreams of the Gomal and the Indus in the Bannu district, Rahman Dheri has yielded evidences for the presence of wheat and barley in the early period dating around C3340 B.C. and C3160 B.C.[251] Tarakai Qila, situated just a few kilometres south-west of Bannu on the edge of the river Tochi, with its major mud-brick defensive walls as also at Rahman Dheri, was evidently witnessing the emergence of an incipient urbanism before the beginning of the third millennium. The same may be said of the settlement at Rahman Dheri.[252] As B. and R. Allchin point out, these evidences indicate the beginnings of urbanism in this area in the centuries preceding the beginning of the Mature Indus Phase. Tarakai Qila has produced massive samples of seeds and grains among which so far identified are several varieties of wheat and barley, lentils (*lens culinaris* and field peas (*Pisum arvense*).[253] The pre-Harappan folks at Tarakai Qila and Rahman Dheri also practised mixed-herding.

It appears that cereal cultivation had taken roots throughout Baluchistan and Sind before the beginning of the third millennium B.C. Technically, the pre Harappan farmers had reached the stage where they selected crops with an eye to ecological permissibility, partial irrigation and mixed-crop

cultivation. It is primarily the rabi crops like wheat and barley that had been taken up for cultivation. The arid weather, an irrigation system dependent on annual monsoonal river inundation or monsoon-fed torrents, as well as the restricted cultivation on alluvial soil are the factors that determined the selection of crops, viz., wheat, barley, lens culinaris (winter crop), and pisum arvense (winter crop) at majority of the Pre-Harappan or Early Harappan sites in these regions. We have also noted that the conception and use of the method of irrigation had dawned upon the Pre-Harappan and early Harappan folks in these parts of the Indian sub-continent. Now, the realisation of the necessity of irrigation arises only when practice of agriculture has developed sufficiently and large agricultural yields were required for growing communities. The area of cultivation has to be enlarged and therefore the land further away from the direct source of water has to be cultivated. The requirement for irrigation is felt by the people in these circumstances. The irrigation construction, as we have seen, required a lot of labour force and organised management on the part of a large, populous community as a whole. The existence of 'Gabarbands' and 'Kach' modes of irrigational constructions presuppose such organisation and concentrated effort as well as a realisation that agriculture was the fundamental economy. Thus, by the beginning of the third millennium B.C., we find that in Baluchistan and even in Sind the economy of agriculture had become the prime force in the socio-economic fabric of the pre and early Harappan life.

Further east from the Indus region, in the Cholistan area the Hakra Ware and Early Harappan sites flourished in the fourth and early third millennium B.C. However, there are no archaeobotanical evidences available for plant-economy from these sites and besides assuming that the people here probably practised herding of cattle nothing more can be said about their economy.

The same is true about the Sothi ware sites further east in the Sutlej, ancient Saraswati and Drishadvati Valleys, except

at Banawali in Haryana, where the presence of circular pits containing fine ash, occasionally mixed with charred grains[254] indicate the possibility of cultivation as far as direct evidences go.

But at Kalibangan in Rajasthan, on the left bank of the Ghaggar river, we have an excellent evidence for the practice of agriculture in a pre-or 'Early' Harappan context around C 2900 B.C.[255] Here, in the Dist. Ganganagar of Rajasthan, we come across an unique example of an ancient pre-Harappan ploughed field lying to the south-east of the pre or 'Early' Harappan settlement, well away from their town-wall. The field displays furrow-marks on a grid pattern. 'The two sets of marks run at right angles to each other and approximately north-south and east-west respectively. The average distance between the individual furrows of the former set is 1.90 metres, while in the latter case it is 30 cms. It was also observed that the north-south furrows with greater intermediary spacing overran the east-west ones with shorter spacing. This shows that the short-space ones were ploughed first and then the ones having greater spacing in between'. '....... the furrowmarks were traced in an area measuring about 14 x 10 metres'.[256]

The above report by B.B. Lal of the cultivation field recovered at pre-or 'Early' Harappan Kalibangan provides a significant insight into the technique of cultivation practised by these people here in first half of the third millennium B.C. The grid pattern of furrow-marks with two types of spacing indicate the practice of double-cropping. Similar pattern of furrowing has been observed in some modern cultivation fields around the site, where the short intermediary spaces were sown with horse-gram and the ones having greater spacing were sown with the mustard plants.[257] Although vishnu-Mittre and R. Savithri's analysis of the samples from the pre-Harappan levels did not reveal any botanical evidence,[258] yet, it cannot be ignored, in view of the above evidence, that the pre-Harappans at Kalibangan had practised agriculture. In fact the practice of double-cropping as evident from the furrow pattern at

Kalibangan suggest an intensive mode of plough agriculture with mixed cropping having been in vogue around the site. A newly discovered pre-Harappan site in the Punjab (Sangrur District)[259] attest the fact that mixed cropping had indeed been mastered by the farmers even at the pre-Harappan cultural stages in the regions to the east of the Sutlej. This site, Rohira produced evidence for a varied crop pattern comprising barley, dwarf wheat, lentil, horse gram, jowar and fruits like grapes and dates. While barley, wheat and lentil as well as the fruits have appeared on the list of cultivation before, it is the appearance of gram and jowar that offers interest. The analysis of the furrow pattern in the field exposed at Kalibangan leads to the conclusion that gram might have been cultivated there. The evidence from Rohira emphasises the point.

The cultural assemblages as well as structural evidences at Kalibangan of this context exhibit that life here was approaching the stages from where an urban civilization would take-off. We have noted similar developments at Rahman Dheri and Tarakai Qila. The 'kot Dijian' of 'Early Harappan' context, as M.R. Mughal calls it, certainly display some signs that presupposes an urban development. At the type site Kot Diji too we note the structural development, viz., massive defensive walls of mud-brick. The presence of stone querns, pestles and some blades bearing 'sickle gloss', indicate the probable practice of agriculture at the site.

Here we would like to discuss the matter of the plough cultivation in the Pre or Early Harappan and Mature Harappan contexts. An opinion runs among a section of scholars that plough cultivation was perhaps not employed by the people of the above cultural contexts. However, the well-preserved furrow-marks at the Pre-Harappan Kalibangan cultivation-field warrant further considerations upon this question. Earlier Ernest Mackay had suggested that very few of the agricultural implements have survived at the Indus Valley sites no doubt because they were almost entirely of wood. It is most likely therefore that the structure of the plough, including the handle

would be made of wood and hence we do not come across a complete piece anywhere. But, as Mackay points out, "One or two roughly chipped objects of chert, not unlike unfinished celts in appearance and averaging in size 11 x 4½ x 3 inches, have been discovered. These have double-sloped edges and as they are much too heavy to have served as weapons they are probably ploughshares and were very likely quite efficient in stoneless alluvial soil of the Indus plains."[260] The soil situation is similar around Kalibangan. Moreover, the Pre-Harappans, especially at Kalibangan, as we shall see in the next chapter, were in possession of a rich copper reportoire. And, as D.P. Agrawal suggests the large number of so-called narrow axes and chisels could have been mounted on wooden handle and used as hoes.[261] In the pliable fertile river-plains, simple copper tools and even big chert blades would help cultivation. Lastly, we have the terracotta model of a plough, 7 x 19.7 centimetres, discovered from Mohenjo-daro, kept in the Prince of Wales Museum, Bombay.[262] The recent discovery of another terracotta model from Harappan levels at Banawali[263] supplement this evidence. Therefore, we cannot dismiss the practice of plough cultivation in the Pre or Early Harappan and Mature Harappan contexts.

Thus by the beginning of the third millennium B.C. the background was set for the urban phenomenon of the Mature Harappan phase with the paraphernalia of an agro-pastoral economy. In this economy cultivation of primarily two cereals, namely, wheat and barley, and some legumes, and a mixed herding of cattle, sheep and goat, with the ass, camel, hemione and dog as other domestic animals, flourished throughout the regions of Baluchistan, Sind and Punjab (Jalilpur) as well as western Rajasthan. The concept and usage of irrigation methods had already dawned upon the pre-Harappans in these regions where rainfall was scanty and the winter was severe. Stone blades attached to wooden handles served as sickles, wooden plough may also have been known as indicated above. Already we note a certain shift of the settlements and

populations eastwards and southwards into the Indus Valley. Fairservis points out the Valley with its ampler water supply and game and richer plant growth, compared to the situation in Baluchistan, attracted the people, albeit the problems of salinity, flood and fever which Wheeler had described as "menacing" and thought to have hindered early man from occupying the Indus valley.[264] As Fairservis points out, these factors appeared to be minor problems compared to the everpresent possibility of moisture failure so prevalent in Baluchistan.[265] This is attested by a greater concentration of settlements in the Indus valley proper and in peripheries in the Mature Harappan times.

IV
THE HARAPPAN CULTURE

Against the previous ideas of the scholars that in ancient times the Indus Valley experienced a wetter climate than at present, Raikes and Dyson have come up with the theory that such was not case after a careful re-examination of all evidences.[266] L.S. Leshnik points out that in these conditions, the Harappans indisputably depended on artificial irrigation, the main source of water having been the Indus system of rivers.[267] The Allchins also agree that there is no convincing evidence of any drastic change in climate during the past four or five millennia in this region. A slightly higher rainfall may be expected throughout the area before the natural vegetation cover was reduced by man's steady intensification of agriculture and grazing but no major shift in climate appears to have taken place.[268] Cultivation was mainly carried out on the river banks. L.S. Leshnik points out that in the Sind as well as in the Punjab the land parallel and close to the rivers locally called at present the 'bet' land was most fertile and drawing benefit from seasonal inundation which leaves rich deposits of alluvial soil. Wheat may be grown on this land.[269] He suggests that the 'sailaba' technique of irrigation may have been practised by the Harappans here. The cultivation fields or 'budhs' would be laid out

judiciously along the numerous inlets and creeks which lead off the main rivers. The dry beds are filled during the floods in mid August-September. When the rivers fall towards the end of October the short arms are transformed into lakes which frequently spill over even before the flood is over and inundate the adjacent low-lying land. Thereafter the remaining water is used for irrigation through lifting devices like the 'shaduf'.[270]

The shaduf is a water-lifting device of considerable antiquity consisting of two poles, one of which is stationary and erect, while the other, attached to the first, moves in a vertical plane. A bucket is suspended from the latter at one end and counter-balancing weights are affixed to the other. It is operated by a single man who pulls the empty bucket down into the water of a well, tank or river and then retrieves the full bucket with ease by letting the counter-weight do the work of lifting.[271] At Mohenjo-daro there is a linear representation of man a using the shaduf.[272] Marshall describes the Mohenjo-daro ring-stones as having slots that were used to fasten the stones to something that passed through the central aperture.[273] This could well have been the arm of a shaduf, to which the stone weights were lashed by rope or leather thongs. The shaduf is prominently featured in Egyptian rural scenes and was also used in Mesopotamia. Leshnik points our that the shaduf is still employed at some parts of India, like Gujarat, near Lothal.[274]

The low-lying areas further away from rivers, collectively called 'Kadir' were irrigated also by the 'sailaba' technique. Here we note an extension of the 'budh' system where artificial courses of 'Chhar' were dug up, leading off from the natural channels of the 'bet' area. On these canals too lifting devices may have been used to bring water onto the fields.[275]

In the Punjab, the uplands locally called the 'bhangar' were chiefly utilised for grazing and cultivation of some rainfed crops like the barley. In the Sind, the western hills

afford good grazing ground. Additional areas of pasture can be found in unarable parts of the irrigated areas although these are more often utilised by agriculturalists to graze their own domestic stocks than specialised pastoralists who were left to graze their herds in the up-lands.[276]

Well-irrigation was also in vogue and perhaps played a major role. L.S. Leshnik mentions that in the present times the wells are additionally used to irrigate the fields in the 'bet' lands nearest to the river in Sind and Punjab and also in the 'kadir' lands in Punjab. The wells of the riverine tracts serve mainly in times of drought. In this area the wells are hardly more than hollows scooped out of earth and seldom lined. Water is raised by the shaduf. Such wells are allowed to collapse after being in use for one or two years.[277] In the 'Kadir' land, further away from the river, the wells are often the single source of irrigational water in contrast to the supplementary character of wells in the 'bet' area. Here the wells are intended to be permanent and hence are frequently lined with bricks. The land directly adjoining the well is the most well-watered and best cared and is sown with wheat.[278] Beyond this zone where water can be easily brought over, there is a tendency to sow lesser crops. The water is raised from these wells by the 'mhote' system which involves the use of bullocks, often a pair of them, to draw a bucket from the well while walking down a ramp.[279] We know that the domestic bullocks were used by the Harappans for draught purposes. They also might have practised this system of drawing water from wells.

As H.T. Lambrick with an intimate knowledge of Sind (a resident of Sind for a long time) suggested, the principal food grains of the Harappans, wheat and barley would have been grown in the 'bet' lands mainly where the annual inundation would facilitate their growing after a flooding had taken place and would be reaped in March or April.[280] Pea (pisum arvense) is also a rabi or winter crop which could have been cultivated in the 'bet' land as well as in the

'Kadir' area. Even in the modern times this 'bet' land is neither ploughed nor manured nor does it require additional water.[281] Lambrick points out that a minimum of skill, very little labour and little aid of implements are required to cultivate this land.[282] C.O. sauer states that it is now apparent that cultivation was carried on in the old world for a long time before there was plough agriculture. A wooden digging or planting stick served the purpose.[283] Bridget and Raymond Allchin point out that the development of this easy mode of cultivation which nevertheless, yielded substantial products, made possible the development of Indus urbanism.[284] However, plough cultivation was probably practised in some areas by the Early Harappan times.

The summer crops like the cotton and sesamum used by the Harappans would be sown at the beginning of the inundation and harvested at its close.[285] Very few of these Kharif crops would be sown in the riverine tracts since this land is under water during most of the summer growing season. Therefore, Harappan cotton must have been grown on the other tracts.[286] slightly away from the main river bed, in the 'Kadir' or even 'bhangar' areas.

As to the actual method of cultivation resorted to by the Harappans and the implements they used, we have already noted that the 'bet' lands required little use of skill and implements. The Allchins.[287] Vishnu-Mittre and R. Savithri.[288] all subscribe to this view of Lambrick. The Allchins and Vishnu-Mittre also suggest that fields may have been surrounded by earth embankments.[289] Thus we find that the natural fertility of the alluvial soil was exploited as well as the phenomenon of annual river inundation. The agriculture of the Harappans therefore depended largely on the seasonal irrigation from the river source.

However, the recent analysis of Shereen Ratnagar[290] raises certain valid arguments in this connection. She emphasises the factor of well irrigation aided by lifting devices in the context of Harappan agriculture especially in

the central region. It has been pointed out that the nature of the Indus and the climatic conditions do not allow for a gravity flow canal irrigation and it was not possible in winter crop season. Most crops, however, were grown in winter — wheat and barley. Shereen cites the categories of crop land classified by Fraser of which, barring one, the rest are dependent on well irrigaion. The conditions of well irrigation were extremely labour—oriented and painstaking. There are numerous instances of wells throughout the occupied area in the Harappan context. Marshall reported grooves at the edges of a well at HR area of Mohenjodaro which were made by friction of ropes. Theoreticelly it is possible that the Harappan farmers lifted water manually with rope and leather buckets or mechanically with a shaduf-type lever ; or using the mhote system. Thus agriculture was extremely labour intensive and lift irrigation might also have severely limited the area of cultivation. Considering the high degree of Harappan urbanism, the achievement of the Harappan farmers cannot be overlooked in any way.

Vishnu-Mittre and R. Savithri brings to our notice a very interesting fact in this connection. They mention that eight years of research and experiments at the Punjab Agricultural University, Ludhiana, shows that tilling or ploughing the land is not essential for the germination and growth of crops like wheat and maize. They have also found out that tilling is required only for weed control. To achieve a minimum tilling a bullock drawn till planter has been developed by this university which sheared off the crust of the soil and stubbles, opened a furrow and sow the seeds as well as apply fertilizer in a single run.[291] Vishnu-Mittre and R. Savithri suggest that the bullock cart known to the Harappans may have been used for minimum tilling.[292]

However, the furrow-marks at Kalibangan clearly suggest the use of a plough, perhaps a wooden one.[293] Other implements like the seed-drill which sometimes facilitates sowing, a wooden hoe with stone blade, a stone-wood

sickle were most probably used by the Harappans as the assemblages at many of the pre-Harappan as well as Harappan sites indicate. Leshnik points out that threshing requires only a team of bullocks to stamp out the grains and winnowing is done with the aid of a wooden stool and a plainted basket,[294] all simple methods that could be and probably was handled by the Harappans.

The Harappan agriculture seems to have been intensive in major respects, especially as suggested by the furrow patterns at Kalibangan indicating the practise of double-cropping there. As Vishnu-Mittre and R. Savithri point out, the same may perhaps be suggested by the mixture of wheat and barley, grams and other grains in the samples from Mohenjo-daro and Chanhu-daro. They also point out that mixed cropping of cereals, like wheat and barley, is practised even today in the Punjab, Haryana and Utter Pradesh as an insurance against weather hazards so that if wheat fails to ripen, the hardier barley is sure to yield.[295] It is not certain whether the Harappans reasoned this out and used barley as a secondary or supplementary crop for times of crisis. However, as Leshnik has mentioned rain-fed (barani) barley may have been grown in the 'bhangar' uplands in Sind and Punjab.[296] Vishnu-Mittre and R. Savithri suggest that the Harappans probably made their bread with a mixture of both the flours of wheat and barley, for barley flour alone is not suitable for the purpose as it is not very glutinous. However, other sorts food preparation like gruel etc. may also have been prepared from these cereals.[297] The Harappan agriculture was also extensive in nature in some respects, especially in the 'Kadir' lands as we have already noted, where artificial canals and wells may have provided the required water supply. The food necessary to maintain a large urban as well as rural population was necessarily raised over large areas. Leshnik [298] thinks that little attention to an efficient land management would have been required in the Harappan times when there was no special pressure

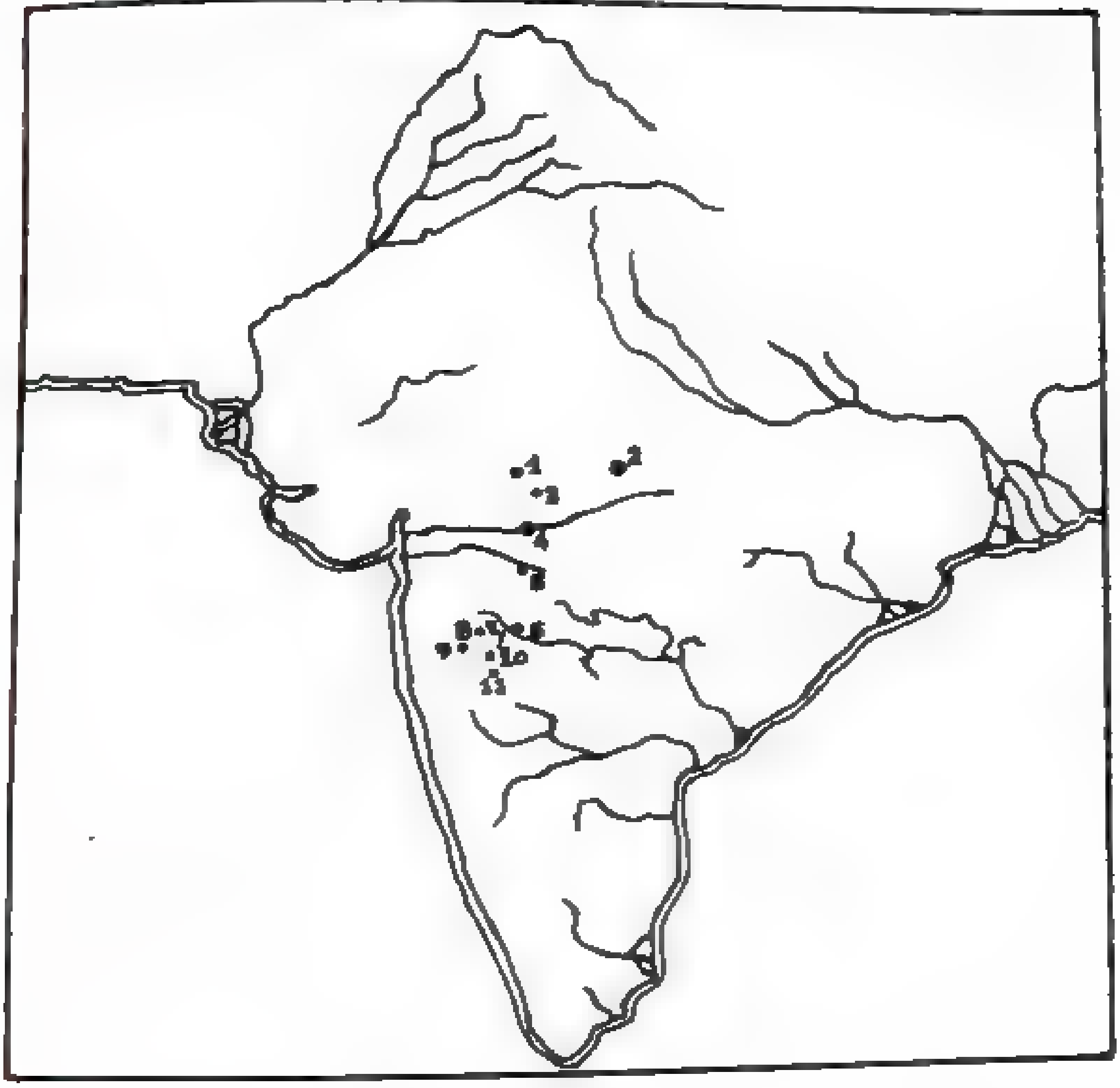
on land as might be inferred from Lambrick's estimate of ten persons per square mile in Harappan Sind.[299] The existence of granaries at the metropolies like Mohenjo-daro and Harappa is very signficant. They indicate that the surplus produce was carefully stored up for times of crises. They may also indicate that the stored cereals may have been items of trade. Most of all, the granaries suggest an authoritative control over the agricultural produce of the Harappan state, whatsoever it was like in character. Here we may note the granary complex at Harappa in some details, as described by Mortimer Wheeler.[300] He mentions that a remarkable group of granaries lay about a hundred yards north of the 'platfrom' area. These granaries, each 50 × 20 feet overall, are ranged symmetrically in two rows of six, with a central passage, 23 feet wide. They are built upon a podium of rammed mud, some 4 feet high and was rivetted with baked bricks along parts of the eastern and western sides and the whole of the southern.

The units of this whole area of the granary complex consisted of, (a) ranges of a barrack-like quarters within a walled compound, (b) serried lines of platforms apparently for pounding grain, and (c) a marshalled array of uniform granaries mentioned above, within easy reach of the river.

Mortimer wheeler suggests that the approach to the granary complex was on the north from the river-bank. He points out that water-transport on the river may have been used for incoming or outgoing supplies of grain.

The architectural features of the granaries indicate a great deal of sophistication in building of the structures. The provision for sleeper-walls, air-ducts and small projecting airvents at the outer ends would suggest that a great deal of attention was given to the matter of preservation of the grain. The sleeper-walls and the intervening air-ducts kept the building dry so as to prevent sweating and mildew. Similar provisions of sleeper-walls and air-ducts have been noted in the similar granaries of Roman forts.[301]

CHALCOLITHIC SITES IN CENTRAL INDIA AND THE DECCAN



KEY

1 NAGDA
2 EARN
3 KAYATHA
4 NAVDATOLI
5 PRAKASH
6 NEVASA
7 DAIMABAD
8 JORWE
9 CHANDOLI
10 INAMGAON
11 SONEGAON

MAP-XI

The above description leaves no doubt as to the concerted attention that was given to the mode of storing and distribution of food-grains in the Mature Harappan context. These were vital factors in the Harappan economy. A great deal of sophisticated and organised management was involved in the total set-up of the agricultural economy. Recently, Marcia Fentress has opened the issue[302] with her citing of the orginal excavator's theory that the Granary structure at Mohenjo-daro might have been a *hamam*. Without going into the details of the issue we may just point out the conclusion that she has come to at the end of her article. According to her the platforms in the said 'granaries' were multipurpose in function. But the general use might have been as a market place as well as a place for social gatherings. Food items might have been displayed or dried there. Fentress points out that these structures were rather unlikely storage places. The recurrence of this kind of public buildings likely to have been used as storage places or market houses since the Pre-Harappan Mehrgarh instance, throughout the length and breadth of the Harappan boundaries, and their location in the major metropolises only, however, keeps the question open. The possibility of dual purpose structures for social activities and commercial operations cannot be refuted keeping in mind later historical traditions in India.

Coming to the individual metropolises of the Mature Harappan culture in Sind we note that most of these sites are concentrated on the flood plain of the Indus, for example, the settlements of Mohenjo-daro, Lohamjo-daro and Amri are situated on the west bank of the Indus, while Kot Diji and Chanhu-daro are situated on the east bank.

Mohenjo-daro is centrally located in the Larkana district of northern Sind on the right bank of the Indus river. It stands on the slightly higher ground of an old meander flood plain a little away from the active flood plain immediately adjacent to the river.[303] The Larkana district has a minimal

amount or rainfall, at best 12.5 cm per year.[304] Even this cannot be relied upon. But the region is the richest agricultural area in sind, the Larkana basin being watered by three sources, viz., the 'nais' or seasonal streams running down the Kirthar range which runs in a south to north direction on the western side of the district. Secondly, a number of seasonal 'nais' also water the basin, originating in the Brahui range and running through the Kachi plains into the Larkana basin. Thirdly, there was the water of the main Indus itself as well as that from the western Nara branch.[305] As Marcia Fentress points out, it is fairly certain that the drainage patterns and the river plains were present in a somewhat similar form in Harappan times as they are today.

Thus the rich alluvial soil, the drainage, and the abundant water resources were the factors which contributed to the growth of such a large-scale settlement as Mohenjo-daro. There are two periods in the year when water is most abundant for crops, i.e., during the monsoon in July and August when snow-fed floods occur in the Indus river and the 'nais', and during the winter in January and February when the Kirthar nais which receive rain from the Mediterranean supply the water. Occasionally there is also slight rainfall on the plains in January and February.[306] Marcia Fentress, however, stresses the point that unless rainfall in the Harappan times was much higher during the winter months (which is not attested by palaeoecological and other evidences), it is most likely that the Harappans practised irrigation of some sort.[307] We have already gone into the details of such proabbilities earlier. Here, we would once more like to point out, as Marcia Fentress has done, that 'the level of technology necessary to build a dam of fairly substantial size was certainly within the capacity of the Harappans'.[308] An abundance of good brick wells at Mohenjo-daro as well as Harappa indicate that digging wells was also within the capacity of the Harappans. They

also most probably practised simple bunding as well as making inundation cuts for flow channels.[309] We have already discussed these systems and their utility in details above.

Ernest Mackay has reported the occurrence of a quantity of wheat grains at Mohenjo-daro from the SD Area as well as in a chamber in L Area on a pavement of Late date.[310] An examination of these grains by Dr. O. Stapf has revealed that both the *Triticum Compactum* and the *T. Sphaerococcum* varieties are represented. However, prof. Percival who also examined the material from the L Area thinks that they belong to the *T. Sphaerococcum* variety exclusively.[311] This late date material has been subsequently dated by radio-carbon to C. 1650 B.C.[312] However, about the samples of wheat from the SD Area, Prof. Percival's examination shows that they may belong to a form of *T. compactum* Host. This variety has been reported from Mundigak in Afghanistan. Mackay also reports that it is an old wheat common in Afghanistan.[313] It will not be surprising if we can trace the occurrence of this variety of wheat in Harappan centres to the ancient southern Afghanistan.

Subsequently, J.C. Luthra referred the wheat samples from Mohenjo-daro to *T. aestivum* subsp. *Vulgare* and *T. aestivum* supsp. *compactum*.[314] Vishnu-Mittre and R. Savithri's examinations and corelations of old charred samles from Mohenjo-daro and modern wheats of all the above-mentioned varieties reveal that the Harappans at Mohenjo-daro were growing and consuming grains of both the *T.Sphaerococcum* and *T.aestivum / T.compactum* groups.[315]

Samples of barley have been recovered from the HR Area and have been identified as *Hordeum Vulgare*.[316] J.C. Luthra has also identified the barley from Mohenjo-daro as *Hordeum Vulgare* Var. *nudum*.[317] Besides these cereals, some badly carbonised date seeds were found in a house in the Vs Area. Mackay points out that though at present the date palm is not a common tree in Sind, but in Punjab large

groves of this tree exist.[318] and there is no reason to believe that the dates were imported from abroad in the Mature Harappan period for they were already present in the neolithic context at Mehrgarh.

Apart from these food plants, Mohenjo-daro has also yielded the evidence for the knowledge and use of cotton as a fibre for textiles. A small piece of woven material was found adhering to the lid of the small silver vase in association also with gold jewellery of the intermediate period. This piece was preserved due to the impregnation of the silver salts.[319] This fragment of cloth was sent for examination to the Technical Research Laboratory, Bombay, where the examination under microscope showed that the sample was undoubtedly made of cotton fibre, the typical convoluted structure of cotton being plainly visible. The fragment was a plain cotton fabric weighing about 2 oz. per square yard, made from 34's warp and weft, and having 60 ends (of warp) per inch and 20 picks (of weft) per inch.[320]. The association of this sample with jewellery of the intermediary period places the date of this piece after the mid-third millennium B.C.

At a later date further samples were recovered from Mohenjo-daro and submitted for examination. These samples were pieces of string found attached to some pottery. Some such strings proved to be a twenty-four fold cotton cord. One sample had a purple colour and it is clear that it was dyed after being manufactured. A few test made on the dyed fabrics makes it apparent that some dye staff of a madder variety was probably used.[321]

A careful analysis and various comparisons between the above samples and modern-day varieties of cotton led Turner and Gulati to the conclusion that the ancient Mohenjo-daro samples are very close to the Gossypium arboreum, neglectum and indicum types which are all coarse Indian cottons.[322] But they admit that no definite variety among these can be ascertained for the nature of the

ancient samples of cotton.[323]

What is important for us here is the evidence that the Mature Harappans at Mohenjo-daro may have known the arts of cotton weaving and dyeing of fabrics. But, considering the evidence for the occurrence of cotton at much earlier times at Mehrgarh in the nearby Kachi Plains, it is no wonder that the art of weaving cotton cloth may have been mastered by the prehistoric settlers in the region around the middle of the third millennium B.C. The occurrence of large numbers of pottery, shell and faience spindle-whorls at Moheno-daro as well as at other Mature Harappan sites attest to the fact that weaving and threading had indeed been a common practice, whether it had been cotton or perhaps sheep's wool. Cotton is usually planted in June and first picked in November. If cotton is grown by well irrigation it is planted in February and picking begins in July.. The temperatures in the Larkana district can drop as low as 35°F in the months of December and January and frost occurs. The cotton plant which cannot survive frost is definitely a summer (Kharif) crop in this part of the subcontinent.[325] In the previous chapter we have already gone into W.A. Fairservis' hypothesis and estimations regarding the population, acerage of land cultivated, and domestic animal stock presumable kept around Mohenjo-daro, hence we need not repeat the matter here.

Further south of the Mohenjo-daro but lying on the left bank of the Indus river is the urban settlement of Chanhu-daro. It is smaller in dimension than either Mohenjo-daro of Harappa. However, located in almost similar ecological setting the botannical evidences from the site would be of interest to us to draw a complete picture of agriculture in the Central Indus Valley. The upper levels of Mound II yielded a number of grains mostly coming from a depth a approximately + 15 feet which places these samples in the Harappa I occupation level.[326]

Dr. F.J.P. Shaw who examined the material concluded

that there were two varieties of wheat grains in the assemblage, one, he indetified as *Triticum Sphaerococcum*, haveing rounded grains ; the second he noted might have been of the *T. Vulgare variety.*[327] In the note, Dr. Shaw also suggested that J.C. Luthra's identification of the wheat from Mohenjo-daro as *T.compactum* [328] may not have been correct and actually these may have belonged to the *T. Sphaerococcum* variety.[329] We have Vishnu-Mittre and R. Savithri's analyses which show that the Harappans at Mohenjo-daro were growing both the *T.Sphaerococcum* and *T.aestivum/compactum* varieties. The same is true of the Harappans at Chanhu-daro.[330] They also report that the Chanhu-daro material consists of an enormous quantity (several hundred) of wheat caryopses from which 160 caryopses of barley could be segregated.[331] Further, the site also yielded two hulled and ten naked grains of barley.[332]

Mackay reports the occurrence of seeds of the field pea, *Pisum arvense* from a depth of + 15.4 feet, below surface, and a seed of the rai or mustard, *Brassica Juncea* also from a depth of + 15.3 feet.[333] However, about the last crop, Vishnu-Mittre adn R. Savithri mention that they did not came across mustard seeds among the material they examined from Chanhu-daro.[334] Nevertheless it cannot be altogether ruled out that mustard, a native of India, may have been known and used as a oil seed in the Mature Harappan days. It is a winter crop and could easily have been grown on the alluvial soil as a rabi crop along with wheat and barley. However, it was not a very important crop as it is very rare even at Chanhu-daro and does not occur at any of the other Mature Harappan sites so far.

The type site of this culture, Harappa is situated on the left bank of a now-dry course of the river Ravi in the Montgomery District of Punjab (Pakistan). M.S. Vats believes that the district must have been a more fertile than at present, when the Ravi comprised two streams instead of one and ran parallel to each other and confluenced at

Harappa. The other river systems watering the Punjab were the Beas which bisected the whole district, as indicated by its ancient deserted bed, and the Sutlej running along the south-east border of the district. Moreover, the valley between the ancient bed of the Beas and the Sutlej was irrigated by two streams, the Sohag and the Para. Vats points out that the waters of these rivers perennially supplied more than ample means of irrigation with seasonal inundations also depositioning rich alluvium for which the Ravi is regarded especially valuable.[335]

Shereen Ratnagar also points out that there is no reason to believe that land utilisation in south-western Punjab, around Harappa could have presented a contrast to that in Sind. However, unlike the situation in Sind where the flood water of the Indus flow out to an appreciable distance from both the banks of the river, here in lower Punjab, the rivers are entrenched and the strip of new alluvium available along their banks for farming is significantly narrower.[336] She also points out that as the nineteenth century reports on Montgomery District mention, the vast tracts of land between the annually flooded tracts of the Ravi and Sutlej could not be cultivated but only put to seasonal pasture.[337] Thus farming settlements could develop only in the fertile riverine tracts which benefited from the annual inundation.[338] As we have already noted in case of the Sind, here also therefore, the 'bet' nearest to the river offers most opportunity for cultivation.[339] The 'Kadir' lands also provided the setting for agriculture. Additional wells were used for irrigation in both these areas in the Punjab. The technique of irrigation was probable the same ('Sailaba') in the 'bet' as that practised in the Sind.[340] Shereen Ratnagar suggests that Harappa, which appears to have been located to the north of the zone of high agricultural productivity and near the southern limits of the pastoral region, owed its urban development more to redistributional mechanisms and an external trade orientation' rather than 'increasing rural productivity and the proliferation

of local exhange systems.[341] In that case, it would of more interest to note the archaeobotanical evidences from this site to ascertain what food products sustained the highly sophisticated populace at Harappa and whether these crops could be grown around the settlement in the ecological setting pertaining there.

Vats reports the occurrence of carbonised remains of wheat, partly lumped together and partly scattered, from two places, viz., the great granary Area in Mound F at a depth of 5 ft. 1 inches, in association with the IIIrd stratum which belongs to the first half of the third millennium ; and the other sample was found in trench of the Mound AB. in association with stratum II.[342] J.C. Luthra identified the first group of grains from the great granary Area as those of wheat, closely resembling the grains of *Triticum compactum*. He mentions that precisely the same variety was found at Mohenjo-daro.[343] However, B.C. Burt, then Agricultural Expert of the Imperial council of Agricultural Research, had reported that the grains resemble strongly those of *T. Sphaerococcum*.[344] Dr. Shaw also stated that the Harappa and Mohenjo-daro wheat grains referred by Luthra to *T. compactum* belonged to *T. Sphaerococcum*.[345] It is likely that both these varieties were grown and consumed by the inhabitants of Harappa in the Mature Harappan day as at Mohenjo-daro and Chanhu-daro. The specimen of wheat from the Mound AB could not be identified with certainty due to their badly carbonised condition. However, the examination revealed that these grains appear to have been those of a species of Triticum of wheat.[346]

A small quantity of charred barley was recovered from Extension Pits I and II in the Mound AB in association with the stratum III, J .C. Luthra, who examined the material, found them to be grains of common husked barley. Burt thought them to probably belong to a small-seeded variety of *Hordeum Vulgare* L.Var. *hexastichon* (six-rowed barley).[347] We have already noted the appearance of six-rowed barley at the Neolithic levels of Mehrgarh. It appears, that these crops had

become quite common in the Sind and later in Punjab.

Besides these cereals, a quantity of charred peas identified by Burt as Pisum arvense L. were recovered from platform P 8 in Trench V. in association with stratum III.[348] The sole archaeobotanical evidence of the occurrence of sesamum in our context comes from Harappa. A lump of charred sesamum or 'til' was found at the eastern and of Trench V. Mound F in association with the IInd stratum. The identification was made at the Punjab Agricultural College, Lyallpur.[349]

As to the occurrence of fruit plants, a few vestiges of seeds of the melon species in a lump of porous earth contained in a earthen-ware jar was found in the Extension Pits I and II in Mound AB in association with the IVth stratum, 9 ft 5 inches below the surface. However, these were too brittle to be successfully lifted up and hence could not be sufficiently examined. However, the occurrence of melons in the arid climate of Punjab cannot be doubted.[350]

From the above evidence it becomes amply clear that cereals like wheat and barley which were basically rabi crops were widely cultivated in the Harappan cultural zone in Sind and Punjab. Oil seeds like mustard and sesamum may have been grown by them. Legumes like peas were also grown by them. Fruits like date and melon were probably also consumed by the prehistoric inhabitants in these regions.

Evidence for the use of cotton also comes from Harappa in the form of clear traces of woven materials on the inside of some faience vases. A temple ornament of the same substance bears an impression of cloth on its underside. Imprints of woven material are also found on two bricks which also show the foot-prints of a man and a dog.[351]

We have already noted the archaeobotanical evidences from the ancient site of Balakot in the Las Bela Plain near the Arabian Sea coast. We have noted that the pre Harappans or Balakotians here were already cultivating the winter cereal barley and winter grown pulses as well as the summer-grown cotton, some gourds and the Zizyphus fruit. All these plants

also occurred in the Harappan levels suggesting that the cultivation of barley, pulses, gourd and cotton had continued throughout the time span from fourth to the third millennium B.C. The Zizyphus was also present in the Harappan levels.[352] M.B. Mckean who has analysed these materials point out that a gamut of plant economic strategies is suggested by the occurrence of the varieties of crop plants, recovered at the site, viz., from collection of local wild food stuffs to small garden cultivation and field agriculture dependent on irrigation/ inundation controls.[353] By the time the Harappan Phase evolved at Balakot, field agriculture with the support of irrigation must have flourished. Mckean mentions that the presence of both winter and summer crops indicate that the Harappans practiced double cropping or intensive agriculture. She also points out that while most of the crops identified may have supplied local economic needs, the cotton cultivation at Balakot suggests the site's importance on an interregional level.[354] It may be assumed that the cotton cultivated here was supplied over a wide area in Sind and even further north and east. G.F. Dales mentions that the main channel of the Windar River, during the periods of flooding especially, was very near the ancient site of Balakot. In other words the site during the Balakotian and Harappan periods was situated on an alluvial plain.[355] Makean reports that there is no palynological evidence from Balakot for more rainfall during the proto-historic period. It goes to show that river inundation and perhaps artificial canals dug from the run-offs of the main river and wells supplied the necessary water for cultivation.[356]

Evidences of utilisation of river water and method of well irrigation has come from the small Harappan site of Allahdino in the Karachi region. It would be of interest to us to note how the Harappans at the site managed the matter of irrigation in the third millennium B.C. at a small site ; how far they have come from the Amrian and Nal modes of irrigation techniques tha we have already discussed.

Allahadino lies to the south-east of Balakot in the Karachi

region in the basin of the semiperennial Malir river. It is a low silt mound rising about three to five meters above the present flood plain of the Malir river and that of its tributary the Bazaar Nadi., lying close to the junction of the present bed of these streams.[357] W.A. Fairservis points out that 'Allahdino' location again indicates the man/land relationship emphasized at Mohenjo-daro Harappa and other riverine sites.[358]

The Malir river system drains an area of considerable magnitude in the kohistan region and its catch basin is responsible for an extraordinary quantity of underground water. Fairservis tells us that the supply.of this underground water was so great that pumping of this water provides irrigation for the Damlotti and Malir agricultural developments at present.[359] The water table is found in the Malir area about 15 meters, which rose in the wells to about six meters below the surface in a good year.[360]

Now, excavation at the ancient site of Allahdino has revealed the presence of two wells of the Harappan phase. These were stone-built and have small openings, one of the wells (well A) is situated in the middle of the southern wall of the courtyard at the central and highest part of the site. Moreover, this well stood even higher, at least 1.25 meters, than the surrounding pavement. A Harappan intersecting circle "bath tub" was attached to its southern side. The well apears to have been a part of rectangular Building IV. This building IV again is attached to another complex of small rooms to its south (which is temporarily called by the excavator Building VII) by another and similar well (well B).[361] Building VII has a broad brick platform with the square and one rectangular pits.[362]

W.A. Fairservis suggests that these wells had served the purposes of irrigation around the site in the Harappan days. He points cut that as we have seen, the Malir system produces a large underground reservoir. The water in wells rises higher than the surrounding water table due to hydrostatic pressure. The smaller the diameter of the well the higher the water will rise. Now, the Harappan wells were, Fairservis suggests,

deliberately kept small in diameter so that the water level will rise higher, and not only that, the water might overflow in artesian fashion. The well openings are too small to lower containers through them. But fairservis suggests that as the central well is located at the highest part of the site any run off from that well could be channelled wherever one wished because of the slope of the site.[363] The divided drain attached to the well A would have ensured that a regular flow of well water could be moved with precision through the stone channels into the surrounding fields via earth cut ditches. This again was helped by the slope of the site itself. Fairservis points that only the practice of such mode of irrigation would account for the site's having been located five or more meters above the Malir river. Water for cultivation of the surrounding alluvium had to be brought to the fields in some regular fashion as this.[364] The archaeobotanical evidences from Allahdino attest the presence of wheat and perhaps barley and a legume of some unidentifiable kind.[365]

The above suggestions of Fairservis are based on pure hypotheses and nothing definite can be concluded on these. However, the theory is attractive and plausible. We have already noted the advances made by the pre-Harappans as well as Harappans in the field of irrigation, and in a climate where rainfall was not substantial people had to take recourse to riverine sources for water.[365a] How else could agriculture flourish ? The people of necessity had to think of ingenious modes of utilising the river water in difficult situations as well as more amenable ones. The mode of well irrigation had been a feature of the Mature Harappan culture. The case of Allahdino, as furnished by Fairservis, cannot be altogether dismissed. In fact, we deem it necessary to consider the possibility in view of the wide scale agriculture development taking place in these regions at the time.

Here, it would be of interest to note that recent excavations in the region east of Bactria proper characterised by mountains and valleys and the Kokcha river, has revealed the presence of

a Harappan site, Shortughai. The site is located in the plain of Daht-i-Qala, at a distance of 5 kms. from the Amu Darya and about 25 kms. from the Kokcha river.[366] Here, we come across the phenomenon of canal irrigation. Sondages dug in proper places revealed small irrigation canals which could be easily dated by the ceramics. The water was supplied by the Kokcha river, 25 kms. away. The lay-out of the system and the manner of utilising the local topographical features talk volumes about the great skill of the Harappan inhabitants here.

As H.P. Francfort mentions there is no equivalent of this system in the deltaic areas of Bactria and Margiana or even in the flooded plains of the Indus,[367] The researches of J.C. Gardin and P. Gentelle emphasise the highly sophisticated character of the system.[368] H.P. Francfort suggests that the irrigation technique could be the result of local tradition.[369] However, J. Gardin points out that this phenomenon may be related to the arrival of Harappan settlers already acquainted with irrigation technology or to an expansion northwards of the people, also of Indian origin, who had settled a few centuries earlier in the Taluqan area[370] whose existence was attested by the findings of potsherds which have parallel to those from Mundigak period III Amri, kot Diji and dated to the beginning of the third millenni B.C.[370a] Francfort reports that the botanical remains indicate the cultivation of central Asiatic species Father than that of India plants.[371] He also reports the discovery of a ploughed field covered with flax seeds in an area hardly suitable for artificial irrigation. Francfort suggests that this show that dry farming was practised side by side with irrigated cultivation.[372] Thus we again come across evidence for plough cultivation in this context, and a new crop is added to our list, the winter crop flax.

Now we move southwards and eastwards from Bactria, into India proper in the valley of the Ghaggar in Rajasthan where a Harappan occupation has followed, after some gap in time, the pre Harappan folks, around the C 2500 B.C.[373] We have already noted that plough cultivation was practised by the

pre-Harappans here. Although no substantial botanical evidence was available for this early phase, the Harappan levels have provided a mass of evidences suggesting the cultivation of a number of crops. Vishnu-Mittre and R. Savithri report the occurrence of a large quantity of barley, *Hordeum sp.* They state that the barleys cultivated by the Harappans at Kalibangan were varieties which produced hulled barley grains. The naked barley producing grains were less in evidence. The presence of twisted hulled grains indicate that the hulled barley cultivated was of a six-rowed variety.[374] The wheat grains, Triticum sp., are present in exceedingly small numbers. Their rare occurrence with hundreds of barley grains as well as their possession of characteristics intermediate between wheat and barley, suggest that either they were aberrant forms from barley or were the result of a few wheat plants that may have grown in the barley fields. However, wheat husks in terracotta cakes and pai provide additional evidence for the presence of that plant and also probable use of the crop by the Harappans at the site.[375] The wheat grains resemble grains of *Triticum Sphaerococcum*. Vishnu-Mittre and R. Savithri have also come across a few charred seeds of gram or chickpea *cicer arietinum* and a single seed of pea, *Pisum arvense*.[376] At Harappan Kalibagan we note primarily the cultivation of winter crops like barley, wheat (probably), and peas. The mode of double cropping might have continued in the Harappan times also. The finding of selenite gypsum in crystalline form sticking to the inner surface of some potsherds leads Vishnu-Mittre and R. Savithri to the assumption that manuring of soil was practised. They mention that this chemical is used in the present times to reclaim saline lands and render them productive.[377] Gypsum occurs profusely in the Rajasthan desert.[378] The occurrence of gypsum in the inner surface of Harappan potsherds indicate that the Harappans gathered and stored gypsum and possibly used it as a fertilizer.[379]

The Harappan farmers at Kalibangan were mainly dependent on the river water for cultivation of crops. Gurdip

singh's hypothesis of a wetter climate in the region between C 3000 B.C. and C 1800 B.C.[380] has ben questioned by Vishnu-Mittre who feels that Singh's selection of pollen indicators for wet climate have not been judiciously chosen.[381] B.K. Thapar has also adequately summed up the archaeological evidences at Kalibangan which go to show that climate was not very wet around the site in the Harappan times. He points out that rainfall was of 'minimal importance' in the conditions that Kalibangan and other Indus cities situated on flood plain environments enjoyed.[382]

Located on the southern bank of the Ghaggar, which is now dry, but must have been a substantial river in ancient times, as indicated by the span of the dry-bed. Kalibangan had an immediate access to a fertile strip of alluvial land. As Marcia Fentress also points out, the tributaries connected with the old Hakra or Ghaggar flowed more fully during the third to first millennia.[383] B.B. Lal points out that in its upper reaches, this stream was joined by the Saraswati which still carries water and in ancient times the combined stream went under that very name. The dry-bed is further traceable downstream in Pakistan under the name Hakra or Ghaggar and might have joined the Indus or might have flowed directly into the sea.[384] Thus, it appears that Kalibangan was situated on an important drainage system which acted as the life giving source to its population, helping in the growth of animal husbandry and agriculture as we have seen. These basic factors were behind the development of a flourishing urban culture at the site during the Mature Harappan Phase. We may point out here that from the Mature Harappan sites in the Cholistan region, the excavator reports the recovery of terracotta models of plough.[385]

We have already noted in the previous chapter that sometime in the middle of the Harappan Period there was an expansion of the Harappan culture and population to the south-east into the regions of Kutch and Kathiawar. We have also seen that ecologically the Sind and Saurashtra were a somewhat contiguous unit with slight differences.[386] L.S.

Leshnik also points out that the extension of Harappan settlements into Kathiawar peninsula represents a natural seeking-out of familiar environmental conditions. The Harappan had expanded to the limits of their ecological zone.[387] The Kutch, however, with a very low rainfall, would not have supported substantial agricultural activities.

Saurashtra, on the other hand, with rivers and streams radiating in all directions provided good setting for the farming Harappan people. They were basically an agricultural people with a specific socio-economic system which served as the basis for a sophisticated urbanised culture. They were very much attached to the land and had attained a high degree of adaptability in different ecological settings as is attested by their successful settlements in such a vast region covering Baluchistan, Sind, western Punjab, Rajasthan and now Gujarat. Wherever they went they carried out crop cultivation and animal husbandry which formed the very basis of their culture.

The chief deciding factors for such settlers were obviously the soil and water. They settled on the banks of the rivers like Bhandar, the Ghelo, the Kalubhar in saurashtra. In Kutch the narrow coastal strip was chosen which is made fertile on the south and north west by the silt of the swift flowing rivers from the central hills. The central region of Bhuj, fairly fertile, was also occupied.[388]

The Harappan farming people in Saurashtra therefore depended mainly on the river waters for agriculture S. R. Rao, the excavator of the major Harappan site of Gujarat which is at present situated between the Sabarmati and Bhogavo rivers in Ahmedabad District, report that traces of canals were found around the site, which are indicative of the existence of dams and canals in the protohistoric period.[389] These two rivers, Sabarmati and Bhogavo are the main drainage systems of this region. The alluvial plain, which extends to the little Rann of Kuch in the north locally called the Bhal was occupied by the Harappans. S.N. Raghunath has reconstructed the

palaeoclimate of the region around Lothal and has come to the conclusion that the climate was not much different from what it is today.[390] Hence the factor of irrigation was very important. L.S. Leshnik points out that at Kathiawar, the Harappans could no longer rely upon flow irrigation as they had done in the Sind and Punjab, for the rivers here do not provide for such use. He suggests that an alternative that the Harappans could resort to and perhaps did was storage irrigation.[391] Here he was referring to the Lothal ; 'dock yard' as S.R. Rao identifies it.[392]

This was a brick basin, 710 by 120 ft. in length, with extant brick walls of 14 ft. in height, running along the east side of the settlement at Lothal. It is claimed by S.R.Rao to have been a dock-yard, connected by channels to the neighbouring estuary. A spill-way and locking device were apparently installed to control the inflow of tidal water and permit the automatic desilting of the channels. On its edge the excavator discovered several heavy pierced stones, similar to the modern anchor stones, employed still by traditional sea-faring communities of western India.[393] On the basis of this 'dock-yard' as well as the geographical location the site was supposed to be an iternational sea-port in the Gulf of Cambay.[394]

Subsequently, Leshnik argued against this theory and offers that the brick-built basin at Lothal served as an irrigation tank as well as a source for drinking water.[395] Bridget and Raymond Allchin regard either of the interpretation as still unproven but favour the latter.[396]

Here we would like to go into the details of Leshnik's postulation regarding the Lothal basin. He points out that here, we have a long, narrow, and relatively shallow enclosure, revetted in brick, with a single inlet channel and perhaps a line of water-lifting devices, viz., *Shadufs* standing along the embankments. He suggests that the inlet channel was connected with the tank at one end and the river, which once flowed west of the mound, at the other. A weir thrown across the river would divert the water to the inlet, the flow being controlled by staging

and, finally by a sluice gate. The fittings for such a gate have been identified at the basin end of the channel. One of the great difficulties with such tanks is that they retain all the silt of the stored water, and must either be periodically cleared, or abandoned.[397] Leshnik points out that the use of the bricks at Lothal eased the cleaning task, provided for a long period of usage, and protected the basin from the erosive force of the water entering through the inlet. He suggests that, when required, the stored water was lifted out of the tank by shadufs and brought to the fields by an interconnecting canal system. The irrigation canals would have presented no problem to the Harappans who were already well-acquainted with drainage canal in their settlements, as Leshnik points out.[398] In fact, we already noted that S.R. Rao reported the traces of irrigation canals around the settlement.

Leshnik puts forward further points in favour of this theory of his. He states that although the region of Lothal is fertile and enjoys and annual rainfall of some 30 inches in *quantity* would suffice to meet the requirements of former yet, the erratic *distribution* of the rains makes agriculture precarious without artificial means for regulating the distribution of moisture to the crops.[399] Leshnik refers to the fact that in the last 2 centuries tank irrigation was resorted to by the farmers in the region mostly during the months of November and December, in order to bring the rice crops to maturity. He corelates this fact with the occurrence of rice at Harappan Lothal, and reasons that, given the fact that, (a) rice was cultivated and that (b) it require the use of stored water and that (c) agriculture was regulated by some Governmental authority as indicated by the existence the granary at Lothal, it would follow that the construction of just such a tank as we have at Lothal would have been an administratively sensible approach to irrigation.[400]

Leshnik further points out that only two wells have been found at the site, one of which was located beyond the habita area.[401] Leshnik suggests that this well might have supplemented

the tank irrigation.[402] The supply of water from wells, in any case, appears to have been limited.[403] He also refers[404] to the opinion of U.P. Shah, who, after a critical review of the Lothal settlement at the mid-stage of the excavation, came to think that the basin served as a reservoir for drinking water. He had conceived the reservoir to have been solely rain fed.[405] But the subsequent identification of the inlet channel shows that water was also drawn from the river.[406] Lastly, Leshnik disclaims the theory of the dock yard proclaimed by S.R Rao by stating that it has not been adequately shown that the basin-like structure was a dock capable of receiving sea-going vessels. The presumed opening for ships in the eastern embankment appears to be due more to the depredations of brick robbers than intentional design, and the conduit, identified as a spill channel, is more likely to have served as an inlet for water from the river.[407] Subsequently, K.H. Junghans has also put forward some points favouring Leshnik's theory. He states that in this region the rivers and canals often run dry during the summer months. He mentions that in Gujarat at present, tanks are built prior to the monsoon rains for the storage of water to be used later.[408] He points out the brick-built tank at Lothal not only facilitated cleaning and prevention of erosion but also admirably suited for the use of shadufs at the water's edge. For in case of a tank built of earthen walls, the walls have to be much sloped to prevent soil movement. In that case it would have been difficult to use shadufs over the sloped walls. The brick walls, which were erect, were very well suited for the use of shadufs. Junghans claims that the occurrence of ring stones at Lothal indicate the use of shadufs at the site.[409]

Although we cannot yet come to any definite conclusion as to the nature of the basin at Lothal, the theory of Leshnik appears to be quite reasonable and attractive. It gives an interesting insight into the probable nature of agricultural organisation around Lothal. Our previous review of the irrigational activities on the Harappans in the different geographical settings indicate that indeed it might have been

possible for the Harappans to organise an irrigation system as envisaged by Leshnik. Not only that, we also find that the Harappan farming people had already acquired the tendency to resort to largescale irrigation techniques to facilitate farming. They took great pains to make the process of cultivation bountiful and rewarding even in adverse situations. To these sophisticated farmers the situation around Lothal might have provided an interesting challenge and the settlers might have tackled the problem of water supply collectively.

The occurrence of imprints of the husks and spikelets of rice have been reported from the Saurashtra sites.[410] Vishnu-Mittre had earlier noted that the rice occurring at Lothal and Rangpur, as we shall see, might have belonged to a wild variety which occurs locally in marshes.[411] However, later Vishnu-Mittre and R. Savithri have come to the opinion that the possibility of rice cultivation cannot be ruled out.[412] S.R. Rao also reports that impressions of reeds of cotton plant and woven cloth used in packing cargo are seen on the terracotta sealings from Lothal.[413] Cotton is a major crop in Saurashtra in the present times. It would not be wrong to assume that the Harappan settlers here, who were already acquainted with this crop, had cultivated cotton for fibre. But most interesting is the presence of rice in this Saurashtra site for here, for the first time, we find the Harappans cultivating this crop. What was the possible reason for the adoption of rice by the wheat-barley-producing Harappans is not yet clear. Y.M. Chitalwala suggests that though there are no physical evidences for the cultivation of wheat by the Harappans in Gujarat it is, however, difficult to imagine that they had ceased to grow it in view of the fact that the initial Harappan settlements are located in the vicinity of the Nal depressions which is an important wheat growing area.[414] The occurrence of rice at Lothal points to the fact that the Harappan farmers were making a full use of the carrying capacity in their environment and that rice was another item in their diet which supplements wheat.[415] In fact the presence of the granary or ware-house in the acropolis area at Lothal is

an indication of busy storing activities on the part of the Mature Harappans at Lothal. The presence of rice-husks in the mud-plaster on the cubical blocks in the building[416] may point to the practice of storing rice in this structure.

The occurrence of rice has also been reported from the other important Harappan settlement in Saurashtra, Rangpur, in the Surendranagar District, on the bank of the river Bhandar. S.S. Ghosh reports that several lumps of burnt or half-burnt mud were recovered from the period IIA (Mature Harappan) levels at Rangpur which bear impressions of plant-like materials. On close examination of these clay lumps the impressions are seen to closely resemble the structure of rice-husk-(*oryza sp.*)[417] He points out that, from the nature of their use, it appears that rice-husks were mixed with the mud as a binding-material for the purpose of plastering.[418] He is also of the opinion that though no grain or spikelet of rice has been observed here, the manner of utilisation of this by-product (husk) indicates the prevalence of rice in the region.[419] We have already noted the opinions of Vishnu-Mittre and R. Savithri as to the presence of rice at Harappan Lothal and Rangpur.[420] Indeed, it is highly probable that the Harappans had taken up this new crop as a supplementary cereal item in their agenda of cultivated crops. In view of such a possibility, the suggestion advanced by Leshnik on the technique of irrigating the rice, a summer crop, in the cold winter months, at least around Lothal, has its merits. In case of Rangpur, it was the river Bhadar, an ancient flow-channel of which is still traceable on the western side of the mound.[421] that provided the moisture required for agriculture. The ancient mound at Rangpur slopes to the north-west and gradually merges with the shallow nullah which marks this original flow-channel of the river Bhadar.[422]

A number of small Harappan and Late Harappan sites have been discovered throughout the Saurashtra. There is no doubt that the Harappans and their descendants found the black cotton soil of the region with its moisture-retaining quality very attractive. The soil can be ploughed with simplest

implements like the wooden hoe[423] or even a digging stick.[424] S.R. Rao suggests that a seed-drill of the type engraved on a terracotta seal from Lothal was another important tool used in agriculture along with wooden plough and sickles, the latter set with stone blades.[425] Harappan, sites from the Punjab, Haryana and Uttar Pradesh also reflect a homogeneity so far as their archaeobotanical evidencs go. The site of Rohira[426] in Sangrur District, Punjab, reveal evidences for cultivation of barley, dwarf wheat, lentil, house gram, jowar, millet and even fenugreek which grows wild in the region. The neighbouring site of Mahorana[427], near Malerkotla, yielded evidence for cultivation of club wheat, six-row barley, lentil and grapes.

Meanwhile, the relentless Harappan farmers were also operating in the regions of Haryana. Banawali in the Hissar District, Haryana, lying on the northern flank of the Rangoi, Nai, Nadi or Hakra Ban, (local names) which is actually the old course of the Sarasvati.[428] has yielded evidences for the occurrence of wheat in the Mature Harappan levels.[429] The excavator, R.S. Bisht has an interesting suggestion for the mode of storing food-grains at these levels at Banawali. He reports the presence of small cubicles in the massive walls of some houses. These generally measure one by one meter and sometimes two by one meters, and have no doors. These were most plausibly blind vaults for food grains. Bisht suggests that if this is so, there should have been one or two opening.[430] One of these would have been at some distance below the ceiling to feed in material in the bin or vault. The other was just above the floor level and was used to gain access to the food grains. Bisht points out that only this postulate explains the probable use of such small cubicles which are otherwise too small to be regular store rooms.[431]

If we accept the above suggestion of Bisht, it appears that the Mature Harappans at Banawali were indeed storing a good deal of grains perhaps wheat, some of which atleast might have been cultivated. on the river bank near the site. The Pre Harappan/Kalibangan strata at Banawali has yielded precisely

circular pits, both large and small, cut deep into the house floors, most of which contain fine ash, occasionally mixed with charred grains. Bisht suggests that these might be the storage silos of bins.[432] Hence, it may have been that the Mature Harappans had made an improvement upon the storing methods of their predecessors at the site. Hulas in District Saharanpur, U.P., gives evidence of a varied crop pattern in the Harappan cultural content.[433] The carbonised grains from Hulas include several varieties of wheat and barley, house gram, peas, green gram, black gram and finger millet. The crop pattern, both from the Gujarat region and the complex of Punjab Harayana-Western Utter Pradesh reveal a crop list very different from the Harappan settlements in the original Greater Indus - Western Punjab region. Temporally, these settlements in the Gujarat and farther east belong to a later date. A question arises, whether we can presume the development of contacts with non-Harappan chalcolithic cultures in the Rajasthan, Maharashtra, Central India and even Karnataka and a diffusion of farming techniques involving new cultigens.

Thus the second half of the third millennium saw the farming economy of the Harappans develop and flourish throughout a wide region covering Baluchistan, Sind, Punjab, Rajasthan, Gujarat and Haryana. This urban civilization had at its base an efficient and well-regulated system of primary production. We have again and again remarked above that the Harappans were basically and a farming people who had developed their basic economy to a level where it could provide a substantial surplus not only for trade or exchange but also for the sustenance of a large non-producing urban population living in the cities. The resilience of the Harappan farmers is exemplified in their sincere and painstaking attempts to cope with a variety of ecological situations, some amenable some quite adverse. Their irrigation techniques reflect not only a developed concept and skill in that field but also a highly organized working system, most probably controlled by the government that existed. The architectural evidences from the

metropolises and semi-towns of the Mature Harappan culture reflect the same sort of technical skill and organisational ability. This is also reflected in existence of the big granaries at the Harappan metropolises, which signify that the collection and storing of agricultural produce was under strict regulation of the state administration, whatever it may have been. There can be no doubt that it was the efficient, regulated and bountiful farming production that upheld the structure of the urban civilization. It was the Harappan farmers who released the Harappan administrators and artisans from the necessity to grow their own food and enabled them to devote their entire time and energy to their special area of activity. An environ of job specilisation was nurtured in the process. Specilised herders, specialised farmer, specilised potters, copper smiths, masons, bead-makers and other artisans as well as scribes, administrators and so on came to give an intricate pattern to the social fabric of the urban Harappan society. It is probable that the farmers and pastoralists lived away from the urban centres in small settlements in the areas where herding and farming were facilitated. In this connection, however, D. P. Agrawal and R. K. Sood are of opinion that there is a dearth of village level settlements as even the smaller Harappan settlements appear to have an urban character.[434]

They suggest that in the Indus and Ghaggar Valleys the extreme vagrancy of the rivers did not allow traditional villages to grow. They point out that agriculture was probably based on the cover and meander flood plaints, which were changing most of the time and therefore required the speed of urban management and resources to cope with the situation, like the present day capitalist farming.[435] Here, it would be relevant to follow the opinion of Shereen Ratnagar who after a somewhat detailed study of puts forward almost a similar theory. However, she does not discount the presence of rural Harappan sites. She says that the Harappan settlements were not all contemporary, nor were all occupied throughout the time bracket of C 2600 - C 1900 B. C., nor did the size of every site

remain constant during the period of occupation. Thus, she makes a point that the Harappan population at any given time may not have been as numerous as a cursory glimpse would show us. Indeed we may agree that to diagnose the exact economic situation based on a general statistical and graphical hypotheses would fall short of complete veracity. Next, Ratnagar asks the valid question that if the food was mainly grown in the countryside how was it made available to city-dwellers? The mechanism that dictated the country side to supply food to the metropolises is a matter of some thought. Ratnagar does not subscribe to the view that a general harvest tax was in vogue on the Harappan rural population. According to her a full-fledged state society which could implement such a revenue system was not in evidence in these times. Therefore, Ratnagar's theory leads to the conclusion that most of the bigger settlements were producing their own food in the vicinity of the sites, which actually clinches the conclusion of Agrawal and Sood. However, we may point out certain factors here. Firstly, there is no evidence available to disprove the idea that some regulative control had reigned throughout the Harappan cultural belt. Secondly, a large number of rural Harappan sites have been unearthed by explorations and excavations, especially in regions of eastern Punjab, Harayana, Gujarat. Again, in view of the enormous amount of cattle requirement both for food, as well as for draught and agricultural labour (including irrigation), the need for fodder would absorb some cultivation area. Most of the larger settlements, were located in regions where there were natural limitations in extensive cultivation. Taking these limitations in view, and the number of non-producing population in the metropolises, it would perhaps not be wrong to assume that rural farmers did supply some amount of food to bigger towns and cities. This is not to say that the cities did not themselves produce some of their own food. It is true, however, that hardly do we find in the wide zone of the Mature Harappan culture a rural settlement of the Vedic type, devoid of all vestiges of sophistication. It appears

that the Harappan farming villages, where they existed, exhibite greater organisation than the Vedic villages. The Harappan farmers were tied up with an urban organization which lent sophistication to their work and life-style and enabled them to handle large-scale irrigational projects and extensive agricultural activities, involving the practice of double cropping also. It was with the degeneration of the Harappan into the Late Harappan culture that gradually led to the slipping off of the urban veneer of sophistication. But there also vestiges of the earlier urban civilization remained. The Harappan, as we have seen, mainly cultivated rabi crops, cereals like wheat and barley, and peas like *cicer arietinum* and *pisum arvense.* The summer crop of cotton was also cultivated by the Harappans over a wide zone. This crop may have been an important commercial item of the Harappan trade. In Gujarat, we note that the Harappans had taken up the cultivation of rice also. We have already discussed at length the farming techniques employed by the Harappans. We found that the implements required were quite simple. We have also seen that the Harappans related mainly upon river water for cultivation. This was essentially because the regions they occupied were not often blessed with high rainfall. It is obvious, therefore, why the river valleys played an important role in the development of the Harappan settlements. This also shows how basic food production was to the development of the urban culture so that the main deciderattum behind the selection of locale for large and small settlements was a perennial or semi-perennial water source, conducive to the activities of agriculture.

LATE HARAPPAN

The beginning of the second millennium saw the gradual decay of the magnificent urban Harappan culture into a spectre of its old self. The devolution of the Mature Harappan into the Late Harappan was attended with the loss of sophistication and urbanity. But in the field of agriculture we find interesting additions to the list of crops being cultivated by the late Harappans, especially in Gujarat.

Rangpur period III (Evolved Harappan or Lustrous Red Ware Culture)[436] has yielded fully carbonised spikelets firmly embedded in tar like matrix and some distinct charred grains of *Pennisetum typhoides* (Pearl millet or bajra). This crop is cultivated in Saurashtra even at present. Ghosh's examination[437] of the plant remains around Rangpur has led him to the opinion that the climate and rainfall in the region had remained the same and has not altered to any great extent from the past. The continuity of the cultivation of bajra, in the circumstances, is quite plausible.

In the Kutch, the Harappan site, Surkotada has yielded a lot of archaeobotanical evidence, pertaining to the period IC occupational levels (Modified Harappan),[438] dated between (1970 B. C. and 1660 B. C.)[439] Here we come across charred lumps of carbonised seeds in an earthen post belonging to this level. Two of the several charred lumps yielded as many as 574 seeds, an overwhelming majority of which were from wild plants. Only about seven percent of these have been identified as being of cereals.[440]

Out of these forty grains have been referred to genus *setaria* (millet). Vishnu-Mittre and R. Savithri, who examined the plant remains from Surkotada are of opinion that possibly cultivated species of millet, Italian Millet *(Setaria italica)*, and two wild species of the green millet, viz., (*S. Viridis* and *S. Verticillata)* are included among these seeds.[441] They also report that a small number of grains represent the finger millet, *Eleusine coranana* (ragi)[442]. This is the second site which reportedly yielded the finger millet in the second millennium B. C. The first, as we have seen, was neolithic Hallur in South India. But the occurrence and probably cultivation of millets in this Late Harappan settlement of western India is very interesting. This may be connected with the arrival of a new culture, following a wide-spread conflagration, at Surkotada. This new culture was characterised by the white painted Black and Red Ware, resembling the ware of the Ahar culture in the south eastern Rajasthan. The residual Harappans seems to have been pushed into the back-ground

by the influx of a new people in the site in period IC[443]. It must be mentioned here that these above types of millets have been reported from the chalcolithic Ahar in Rajasthan. In the circumstances, it may not be wrong to assume that already a new cultural wave characterised by newer food habits, ceramic repertoire as well as a different type of metal-works as we shall later see, was breaking on the Western India. The Hallur evidence should also be taken up together to identify new links.

No significant archaeobotanical evidence comes from any of the other Late Harappan sites either in eastern Punjab or Haryana except from the Late Harappan levels at Daulatpur in Haryana, District Kurukshtra, where charred grains of the pulse *Vigna mungo (Phaseolus mungo L)* or Urd have been recovered.[444] The occurrence of this crop here is interesting for it has not been included within the list of cultivated crops of the Harapans. Moreover, the other chalcolithic sites so far excavated, in the neighbouring states have not yielded the evidence for this plant. It is only the central Indian sites of Navdatoli, Maheshwar and the south Indian neolithic site, Paiyampalli that are reported to have yielded such evidence. It appears from this that at some sites, throughout the pre and protohistory in the Indian sub-continent, independent experiments were being carried out all the time with the wild plants available in the region and dietary habits were constantly being enlarged and adjusted to the availability of foods. This kind of experimentations were responsible for the demostication of wild plants everywhere in this sub-continent, as we have seen in case of rice at Koldihwa, and perhaps even wheat and barley at Mehrgarh where we clearly cannot identify a diffusionary mechanism from the West Asia introducing these crops into the Baluchistan. The Late Harappan sites in the Punjab and Haryana, for example, Kotla Nihang Khan, Sanghol, Bhagwanpura, and those in Western Uttar Pradesh, viz., Alamgirpur, and Hulas, exhibit a decaying Harappan urban environ, the cultural assemblages indicating probability of farming economy having been practised. On the other hand smaller sites like Dadheri, Katpalon and Nagar, all in Punjab,

exhibit village-level settlements which might have been ancillary to the larger sites in the region. It should be noted that the Harappan potsherds and burnt plaster found in the excavations at Hulas and in explorations at Un on Katha Nala, both in western Uttar Pradesh, revealed traces of rice-husk used as degraissant.[445] On examination, the ornamentation pattern of the husk revealed characters common between the cultivated rice, Oryza Sativa and the wild perennial, O. rufipogon.[446] We have already noted the occurrence of rice at Lothal and Rangpur. It appears that in the eastern regions of the Harappan cultural zone the farmers were gradually becoming more and more familiar with this cereal that was new to them.

V

OTHER CHALCOLITHIC CULTURES OCHRE-COLOURED POTTERY CULTURE :

On the borders of the zone of Harappan-Late Harappan cultures, the OCP culture was flourishing at several sites in the Ganga-Yamuna Doab as well as at Rajasthan and Chandigarh around the second half of the third millennium B. C. and the beginning of the sécond millennium B. C. (Jodhpura radio-carbon dates range between C 2500 and 2300 B. C.)[447]

Excavation at Atranjikhera, District Etah, Uttar Pradesh, has provided us with interesting informations regarding the food habits and agricultural practices of the people of this culture in the central Ganges-Yamuna doab. The doab, the alluvial plains of the Ganga and its tributaries, couched originally a thick monsoon-fed forest. The soil is meadow type. The older alluvium (bhangar) is overlain with the newer alluvium (Khadar).[448] However, the older alluvium was Kankary and very difficult to plough without heavy and strong iron plough shares. This doab with its primeval dense forests and the hard calcareous soil could not be colonised on a large-scale by the Copper-Bronze Age people.[449] The OCP settlements in the heart of the doab must have been very small in size.

At Atranjikhera the earliest settlers, associated with the Ochre Coloured Ware, occupied the settlement for the first time

around the first half of the second millennium B. C. The habitational remains, as we have already seen in the previous chapter, indicate that the settlement was a small village. The mound lies on the right bank of the Kali Nadi, a tributary of the Ganga which definitely facilitated cultivation. The region also receives adequate rainfall. K. A. Chowdhury reports that an analysis of annual rainfall for the last 50 years in seven western districts of Uttar Pradesh, shows an average of 690.5 mm. The monsoon months of June, July and August bring a lot of rains, almost eighty percent of the annual rainfall. Hence, rainfall also provided a good supply of water to the crops cultivated. The soil of the region is alluvium, the new deposit is *Khadar* and the old, bhangar.[450]

A close examination of mud-clods and wall-plasters yielded charred caryopses of cereals embedded in them. The material when examined revealed the occurrence of cereals and pulses in the Period I levels (OCP culture) at Atranjikhera. The cereals represented are rice and barley.[451] K. A. Chowdhury identifies the rice from Atranjikhera as the *Oryza sativa* L. of the South Asian origin. He also reports that the rice was of a cultivated variety.[452] The barley from Atranjikhera, *Hordeum* sp. was of a cultivated, hulled, six-rowed, H. Vulgare L. complex type,[453] a barley which is extensively cultivated throughout Northern India at present. The pulses recovered from this period are *cicer arietinum* L. (gram) and *Lathyrus sativas* (Khesari).[454]

Thus we find that the OCP folks at Atranjikhera grew two cereal crops in the year, the barley in the winter and the rice in summer. This is the first clear instance of cultivation of two types of cereals — Kharif and rabi at an O.C.P culture site. As K. A. Chowdhury points out this practice was of a great economic importance.[455] We have already obtained evidence for double-cropping at pre-Harappan Kalibangan and noted the indications of cultivation of both Kharif and rabi crops at some other sites also. This may indicate that, firstly, in this geographical region rice had replaced wheat as a staple diet ; secondly, that a year-round cultivation and supply of cereals

was necessarily in vogoe. The agricultural scenario was further enriched by two pulses, both winter crops, both legumes which, as K. A. Chowdhury points out, improve the nitrogen contents of the soil.[456] The use of the rice husk and small particles of chaff in clay-plaster[457] indicate the farmiliarity of the crop and its wastes. Fragments of querns and pestles are also supportive evidences.[458]

R. C. Gaur has pointed out that there was no sign of abundant use of the above food crops. He suggest that possibly the period I at Atranjikhera witnessed a stage when the inhabitants were mainly food gatherers and the growing of agricultural crop was an experiment.[459] The above evidence indicates that the OCP folks had attained success with their experiments and were handling a multiple-crop farming throughout the year. R. C. Gaur points out that since the barley cultivated at Atranjikhera is similar to the Harappan variety of contact between the OCP people here and the Harappans in Sind and Punjab may be indicated. The gram *(Cicer arietinum)* also come from the north-west.[460]

Unfortunately, none of the other OCP cultural sites in the Ganga—Yamuna doab has provided such extensive information. But the evidence from Atranjikhera may serve as a model for the understanding of the agricultural environment in the region. It is clear, that at Atranjikhera we are faced with a rural environ as compared to the magnificient urban milleu we had been so far been dealing with.

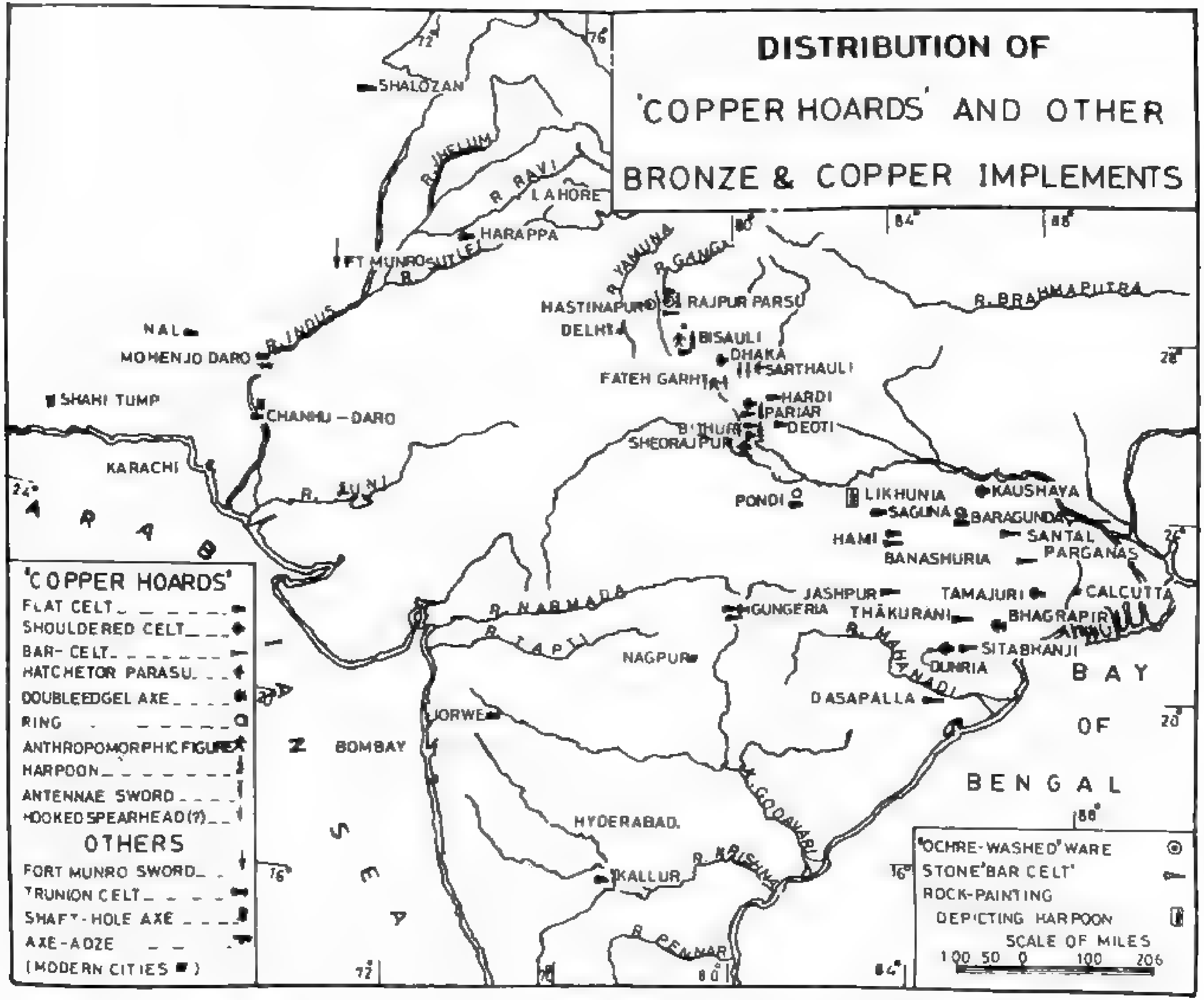
BANAS/AHAR CULTURE

At Ahar, in the Banas Valley, south-eastern Rajasthan, a chalcolithic settlement had developed around C 1940 B. C.[461] as we have already seen in the previous chapter. As Sankalia points out, the Banas Valley, including the Udaipur region, was colonised by a food producing, copper-using people (Banas Culture or Ahar culture) by at least C 1700 B. C.[462]

The site at Ahar is situated on the river of the same name, about two miles to the east of the Udaipur town. Mewar receives a rainfall of over 100 cm and near the hills to 60 cm in

the north-eastern side.[463] A few metres of the river alluvium lay on either side of the settlement. But otherwise the site is surrounded by out-crops of achists and quartz. The rich fertile silt laid down by the Ahar river on eitherside of its bed form a terrace about 20 feet higher than the water level. As Sankalia points out the settlers made the best use of the environment. The enlosed valley where Ahar is located gave them protection, and the river provided fertile soil and water. The settlers used the rock around them for building purposes and the region, rich in copper, gave them the incentive to start a copper metallurgy.[464]

The archaeobotanical evidences from the site, viz., impressions of grains and spikelets on potsherds, indicate the presence of two crops. The two kinds of impressions, viz., one oblong and another small and round to avoid cavities, belong to the rice and millet respectively.[465] With a few exception, almost all the sherds show impressions of rice-husk. The chess-board pattern of the outersurface of the spikelets is well preserved and from the size of the spikelets and grains they unmistakably appear to belong to the long-seeded variety of *Oryza sativa* Lin. Var. *Sativa* Bor.[466] Sankalia suggests that this may have been the ancestor of the famous Dehradun rice.[467] Some potsherds bear impressions in the form of cavities which are motly ovoid in shape and more or less round. Vishnu Mittre puts forward that these impressions belong to cultivated plants because of the presence of impressions of cultivated rice. Secondly, they seem to belong to the cereals. Thirdly, the morphological characters of these impressions compare well with the spikelets and grains of millets and preclude the possibility of their belonging to any wild grasses. Vishnu-Mittre's examinations point out that the variety of millet possibly cultivated by the chalcolithic Aharians was of the *Sorghum vulgare* variety of Jowar.[468] He also points out that Vavilov[469] held *Sorghum vulgare* to have had an Indian Centre of Origin. However, Vishnu Mittre prefers the theory of De Candolle that *Sorghum* Originated in Africa and was later introduced into Egypt and then into India and finally reached



MAP XII Map showing the distribution of 'Copper hoards' and other bronze and copper objects

China.[470] He points out that the site of Ahar belongs to a part of North-West India which has been an important cultural route between Central India and Egypt.[471] The suggestion is that from Egypt sorghum was introduced into north western region of India in Rajasthan. We have already noted the presence of millets in South India and discussed in some details the question of its diffusion into India from Africa. It is likely that Ahar lying on the route to the Peninsular India might have obtained the species and adapted it to their requirements. However, nothing conclusive can be said about the occurrence of jowar at Ahar, except that the chalcolithic folks were familiar with it and perhaps cultivated it as another staple item after rice. For, while rice occurred throughout the period I levels at Ahar, millet occurred only in the top levels of period I which are often found to be disturbed. Sankalia therefore points out that this cereal was probably used by the people in period II at Ahar.[472]

What is more significant here is that once more we come across the rice in a non-Harappan chalcolithic context. This time in south eastern Rajasthan. Significantly, the Harappan settlement of Kalibangan, also in Rajasthan, had not yielded evidence for the occurrence of this crop. The Harrapans we have seen, had never taken recourse to rice anywhere except in Gujarat. Therefore the preference for wheat and rice as staple foods may be taken to indicate different cultural backgrounds as well as different ecological situations. Vishnu Mittre also points out that the absence of the spikelets and grains of wild rice from either the impressions or charred grains at Ahar suggests that the domestication of wild rice had taken place already in the region,[473] earlier than Harappan experiment with rice at Lothal and Rangpur perhaps. Besides the archaeobotanical evidences, the presence of saddle querns, pounders[474] and large storage jars embedded in the floor of houses also attest to the practice of utilising food grains and storing them.[475]

The total picture of Ahar is that of a prosperous and advanced agricultural settlement, rich in ceramic and metal repertoires, with an adequate agricultural and herding economy (as we have already seen). They may have had some connection with the Harappans in northern Rajasthan as far as some affinities in pottery shapes indicate.[476]Here, we would like to raise one point that it has been recently accepted by scholars that copper ore used by the Harappans largely came from the mines in Rajasthan.[477] We shall discuss in details the matter of relations between the Harappans and the chalcolithic folks in Rajasthan as far as the metal industry is concerned in the next chapter. Hence, some sort indirect connection on the lines of a trade link may have been in vogue in many parts of Rajasthan, especially in Jaipur, Udaipur region. However, as far as agricultural economy was concernd we find no such indications of influences, except perhaps the presence of rice both here and at Lothal and Rangpur.

Over fifty sites of the Ahar culture are known from Udaipur, Chitorgarh, Bhilwara, Ajmer and Tonk districts in the valleys of the Banas and its tributaries.[478] However, besides Ahar, excavation has only taken place at another site Gilund. It appears that a rice consuming chalcolithic people living in semi-rural or fully rural settlements had occupied the valleys of the rivers Chambal and Banas in the first half of the second millennium B.C.

MALWA CULTURE

South-west of Rajasthan, in the Malwa region the sites Maheshwar-Navdatoli were witnessing a prolific farming activity. The Malwa region, lying almost in the heart of India, forms a link between the Indo-Gangetic plain and the peninsular region. It is drained by two river systems, the Narmada, Tapti amd Mahi which join the Arabian sea and the Chambal — Betwa flowing into the Yamuna. The climate is of a tropical monsoon type. The average rainfall is about 106 cm. The black soil, which occupies almost

entire Malwa, is known for its fertility.[479] However. the earliest chalcolithic settlers might have been able to cultivate mainly on the alluvial strips on the river banks, for the black soil, although fertile, was quite heavy and sticky and required strong metal implements to loosen it and sow seeds.[480] Hence, although very small-scale cultivation in this black cotton soil cannot be ruled out, such activities could never have been large-scale.

Maheshwar, in the Nimad district, fifty miles south of Indore, is situated on the northern bank of the Narmada, while Navdatoli is located exactly opposite on the southern bank. There is no doubt that the river water and the alluvial deposit facilitated agriculture to a great extent.

Examination of the archaeobotanical evidences show that chalcolithic farmers at Navdatoli cultivated wheat gram, peas, rice and pulses like mung and masur.[481] Vishnu-Mittre who examined the botanical material from Navdatoli-Maheshwar, comprising carbonised cereals, legumes, fruit remains and oil seeds, states that here we come across the first important comprehensive collection ever discovered in India, presenting a great variety of plant remains suggesting a large choice and intense practice of cultivation. Vishnu-Mittre has identified wheat grains of the *Triticum vulgare compactum* type (*T. vulgare* vill. or Bread Wheat and *T. compactum* Host or Club Wheat), in almost all the samples.[482] The grains of rice occur less frequently and are entirely absent in the phase I of period III.[483] It appears therefore, that in the early days of the Malwa culture rice was not yet cultivated, (around the 1600 B.C.).[484] This crop occurred at Maheshwar-Navdatoli in phase II levels associated with the Jorwe culture. Wheat was also being cultivated quite profusely in this phase. Rice is less frequent, but continues to be culivated with wheat from phase II to IV. The species of rice was identified as *Oryz sativa* L., the only cultivated species in India which also occurs wild in the marshes of Rajasthan, Sikkim, Bengal, Khasi Hills as well as central India.[485]

Next come the pulses. The grains of lentil *Lens culinaris* have been reported to be mixed with those of cereals and legumes in all samples. It is a winter crop and of rare cultivation in the south India. Vishnu-Mittre points out that the lentil is, however, largely cultivated in northern and central India and in the foot hills of the Himalayas at present.[486] The grams, both black gram or Urd (*Phaseolus radiatus* L.)[487] have been recovered from all the periods, except that the black gram is absent in phase IV.[488]

Next there is evidence for the occurrence of the grass pea *Lathyrus sativas* L. a winter crop.[489] Another group of grains, seeds resembling those of *Pisum sativum* in shape but very small in size have also been recovered and identified by Vishnu-Mittre as *Lathyrus* sp.[490] Besides these, several seeds, presumably of weeds, have been found in the samples, mixed with the various legumes.[491] Some of these have been tentatively identified by Vishnu-Mittre as : *Pisum arvense, Lathyrus Sphaericus, Vicia sativa and V. tetrasperma.* Of these, the *Pisum arvense*, as we have seen, had been cultivated as a winter crop by the Harappans in the nort-west of the sub-continent. Vishnu-Mittre points out that, from the nature of the samples, it appears that these plants were not deliberately cultivated, but were probably gathered for food. Their occurrence among the wheat and the pulses suggests that they were accidentally reaped together with the main host crop. However, Vishnu-Mittre also suggests that the possibility of some of them having been cultivated can not be overlooked.[492] Very interesting is the occurrence of the oil seed Linseed throughout all the phases, except phase II. Vishnu-Mittre states that the frequency of its occurrence increases four times from phase I to phase IV.[493] We have only one record for the occurrence of flax or linseed earlier at Harappan Shortughai. But there perhaps it was used as a fibre, whereas here most probably oil was extracted and used from the plant.

Among the fruits, the Indian jujube or 'ber' occurs rarely,

except in phase III.[494] The variety of ber *Zizyphus jujuba* Lamk, however, occurs commonly[495] throughout all the phases, especially in phase II.[496]Amla or Myrobalan occurred in Phase III only.[497] The above evidence shows that the Ahar cultural people at Navdatoli-Maheshwar were cultivating wheat and some pulses. Rice was introduced later. Agricultural activity seems to have become more intensive during the phases II and III, i.e, especially during the Malwa cultural phase. Phases I and IV witnessed a slug in the agricultural activities. A graph for cereals shows that wheat cultivation may have declined gradually from phases I to IV, especially in the last phase, while that of the rice shows a gradual increase, especially marked in phase IV. The graph for legumes reveal that lentil declined in importance from phase I to IV as well as the grams whereas, the grass pea (*Lathyrus sativas*), a winter crop gained importance in phases III and IV, during which all other legumes declined in importance.[498]

The Malwa setters at Maheshwar-Navdatoli lived in modest mud and bamboo houses, used well-made chulas, possessed the typical Malwa ware and used some copper implements. They practised a rich and varied mixed-crop agriculture, comprising cereals and pulses and as we have seen earlier a mixed-herding economy in which the cattle played an important role. Maheshwar-Navdatoli provides a picture of a comfortable village life with a flourishing agricultural and herding economy in the Malwa region, on the banks of Narmada in the second half of the second millennium B.C. There are no indications of large-scale irrigating activities. The fertile black soil and the river alluvium as well as the congenial climate saw to it that the agricultural economy flourished, but the area of cultivation was restricted to small strips and clearings. Here we find a greater variety of cultivated crops than at any of the Harappan sites even. This indicates the fertility of region and the favourable climate rather than great skill on the part of the

farmers. But, it should also be remembered that at this late date (second half of second millennium) a lot of crop had already been experimented with and cultivated at a number of sites in the Indian sub-continent. In the absence heavy metal tools which could loosen the heavy black soils in the forested areas, cultivation was restricted to small clearings and the alluvial strips near river valleys. Thus, extensive cultivation was not possible although the farmers here were experimenting with a larger variety of crops. Again in the absence of irrigation facilities, dry farming in winter season limited agricultural yield and also the crop pattern of this region to those varities like bajra, jowar and winter legumes and pulses. Therefore, here we have primarily rural folks, who had little to do with a urban sophistication or a larger-scale surplus production associated with urbanity. The practice of agriculture here, though intensive in phases II and III, could not have compared to the large- scale cultivating activities in the Harappan society.

The Malwa culture (C 1700 - C 1400 B.C.)[499] spread into Maharashtra in the valleys of the Tapti and Godavari-Pravara system. Daimabad, Dist. Ahmednagar, Maharashtra, situated on the left bank of the Pravara, witnessed the appearance of the Malwa culture in phase II. The people of this culture introduced copper at the site.[500] But recently a Savalda Ware Culture (phase I) has been identified at this site preceding a Late Harappan Phase (II). S.A. Sali, one of the excavators of the site, identified this culture and dates it between C 2200 and 2000 B.C.[501] Vishnu-Mittre reports that the food-economy of the Savalda Ware people consisted of the cultivation of Jowar (*Sorghum* sp.), barley (*Hordeum* sp.) and lentil (Lens culinaris).[502] The Phase II levels yielded the evidence for occurrence of barley only.[503]

The Malwa culture folks at Daimabad, however, cultivated a number of crops, viz., barley (*Hordeum* sp.), pea (*Pisum* sp.), horse gram (*Dolichos* sp.), lentil (*lens culinaris*) and mung (*vigna radiatus*). Besides these, the Malwa inhabi-

tants at Diamabad also enjoyed the 'ber' or Indian jujube.[504] The legumes are quite similar to those cultivated by the Malwa folks on the banks of Narmada. However, the horse gram is a new addition here. The cultivation of barley has also been reported at Inamgaon. The cultural assemblages of the Malwa people at Daimabad indicate that they were a rural farming folk with a metal repertoire akin to the people at Maheshwar-Navdatoli. The Pravara basin, a rich fertile region backoned to the farming people as the Narmada valley had in Malwa.

The Malwa cultural levels at Inamgaon, district Pune, Maharashtra, yielded evidences indicating the cultivation of wheat, barley, lentil, horse gram or Kulthi (*Dolichos biflorus* L.), *Dolichos lablab* L, peas (*Pisum Sativum*), mung, Khesari (*Lathyrus sativus*) and a legume of *Vicia* sp.[505] found mixed with seeds of barley, Khesari, horse gram and mung.[506] Oil seeds of the Chiraungi variety (*Buchanannia* sp.) have also been recovered from the Malwa occupational levels at Inamgaon.[507] Besides these, fruits like the *Zizyphus mummularia* (type of ber) and *Phoenix sylvestria* Roxb. were also eaten by the inhabitants at Inamgaon.[508] A number of above mentioned plants were also cultivated and consumed by the Malwa folks at Daimabad, as we have noted.

The site of Inamgaon, situated on the right bank of the river Ghod, a tributary of the Bhima, offers a lot of advantage for farming settlers in an otherwise semi-arid climate.[509] Geologically, the region around Inamgaon forms part of the Deccan trap. The region generally consists of stony uplands and rugged valleys. But towards the river the land slopes into more open plains. In some cases the uplands have rich tracts of black cotton soil which is very productive with a scanty rainfall. The area along the river Ghod upto its confluence with Bhima also has a fair share of rich black soil. But here the soil cover is thin and hence the region is throughout sparsely wooded.[510] This, instead of hindering

agriculture, assisted it, for here there were no large trees to fell. As Dhavalikar points out, the earliest settlers at Inamgaon chose a spot quite close to the river.[511] We must also mention here that the massive columnar basalt rocks on the left bank of the Ghod near this point form a sort of barrier to the flow of the river water and a large pool of water is formed here in the river which also helped cultivation.[512] In the Malwa period the size of the settlement gradually became quite extensive. The large tracts of black soil and the perennial source of water in the Ghod must have attracted the settlers, who might have been pioneering farmers from Malwa coming into the Maharashtra from C 1600 B.C. onwards.[513]

JORWE CULTURE

The Early Jorwe period dawned on Inamgaon around C 1440 B.C. Now the planning of the settlement shows some discipline, the houses being spaced at regular intervals with the intervening space forming a sort of road or lane. The Early Jorwe period saw a further extention of the settlement, spreading over the whole of the site. The houses were large, rectangular mud structures.[514] The most interesting architectural evidence of the Early Jorwe phase is the huge diversionary embankment wall. This wall was constructed of rubble, set in mud mortar at the base. The upper part may have been earthen. A channel, 4 metre wide and 3.50 metre deep was dug parallel to this wall.[515] This channel almost joins the large feeder stream of the right bank of the river Ghod in its southern end. The flood water from the river could easily be siphoned through the channel. Dhavalikar points out that there is a great probability that the water from this channel was used for irrigating the low-lying fields nearby.[516] This is the first indication of structural activity concerned with artificial irrigation in the Deccan chalcolithic context.

The Jorwe Phase saw the cultivation of all the crops mentioned before as being cultivated by the Malwa farmers at Inamgaon, viz., wheat (Triticum compactum),[517] barley of

both hulled and naked varieties, the former being most numerous, some of which belong to the *Hordeum vulgare* variety and some correspond to the six-rowed variety of *Hordeum hexastichum*,[518] lentil (lens esculenta),[519] Kulthi or horse gram, i.e., Dolichos biflorus L. as well as Dolichos lablab,[520] peas,[521] legumes like mung (*Phaseolus radiatus*)[522] and Khesari (*Lathyrus sativas* L.).[523] The oilseeds of Chiraungi variety were also found at the Jorwe levels.[524] But, besides these crops, two cereals, the rice (*oryza sativa* L. *var. sativa* Bor)[525] and Jowar (*Sorghum Vulgare*)[526] were introduced in the Jorwe Phases. Rice occurs only in the Late Jorwe Phase while jowar appears in the overlap between Early and Late Jorwe periods. Incidentally, we must note that at Navdatoli-Maheshwar also, rice made its appearance with the Jorwe culture. The Malwa culture there had a wheatbased agricultural economy as at Inamgaon. The presence of sorghum at Inamgaon and Daimabad as at Ahar, strongly suggests cultural diffusion from the latter site in Rajasthan to Maharashtra. Inamgaon records the second occurrence of the winter cereal, barley, in Maharashtra after Daimabad. It appears that the Jorwe farmers had taken recourse to this crop as a supplementary one at Inamgaon. But at Daimabad, it was the sole cereal cultivated. Here we may mention that a unique structure has been encountered in the Jorwe levels at Inamgaon, not far from the elite area which is located in the centre of the principal mound. M. K. Dhavalikar points out that the structure contained a number of pit-silos and round platforms for storage bins of various sizes, all disposed in a very orderly fashion for storing different kinds of grain. In some cases the sides and the bottoms of the pits were lined with lime, in case of others, the bottom was full of sand. No remains of grains have been found in the pits. There were also two large fire pits. M. K. Dhavalikar suggests that the structure could have been a granary. However, the presence of fire-pits also indicate that it may have been a temple for fire worship where people

may have paid tribute in the form of grains which was stored there.[527] This is a significant indication of organised religion associated with the economy of agriculture.

The Jorwe settlement of Nevasa, district Ahmednagar, Maharashtra, has yielded a unique evidence for the knowledge, occurrence and use of the fibre silk along with cotton.[528] A. N. Gulati reports that a copper beads necklace found around the neck of the skeleton of a child buried in grey urns at the site, at a depth of 28 to 75 feet, exhibit a string made of silk. Remnants of this silk-string were found inside three beads only. The ends of the string had a light greenish tint, indicating saturation with copper salts.[529] The remains of the string, of which only about 2 mm. of length could be ultimately recovered, when examined under a microscope, revealed that the fibres used in the manufacture of the string cannot be any other than of natural silk.[530] It is also indicated that the material is from a homogeneous population and not derive from two different sources. Gulati reports that the fibres under study are apparently derived from very fine silk.[531] Examinations also revealed the presence of a nep of cotton fibres in the body of this string which, as Gulati suggests, may indicate that the silk thread had been spun on a cotton spinning appliance.[532] Thus, here at Nevasa, we are face to face with a startling discovery which takes back the use of natural silk to about 1500 B.C. to 1000 B.C. Nowhere else, in our context, do we come across actual physical evidence for the occurrence of silk. Evidence for the use of linseed as flax fibre comes from the discovery of spun fibres at Chandoli, District Poone on the bank of the river Ghod.[533] The fibre was earlier noted to have been probably used in Harappan Shortughai.

The above survey of the farming economy of the Malwa and Jorwe Cultures in Central India and the Deccan reveals that here small rural farming communities were striving towards a more affluent economy based on primary production. The people were basically farming folks

experimenting with the locally available and perhaps some introduced crops in a typically tropical, semiarid, black-cotton soil ecological context. The cultural assemblages indicate that they lived a simple social life and definitely possessed a copper implement repertoire. The evidences also indicate that they were yet to attain the levels of sophistication required to develop an urban society and economy. As L.S. Leshnik has pointed out, in contrast with the Harappan peasants who were members of a larger stratified urban society and had an obligation to produce a surplus, the farmers in the Chalcolithic Central India and Deccan, cultivating the riverine alluvial strip and Black cotton soil, belonged to a simpler folk society.[534] In such a society the goal and probably the limit of agricultural production was the satisfaction of communal needs which were definitely very moderate compared to those of the Harappan society. Thus, here we are probably dealing with a subsistance level agriculture. Leshnik points out that there was indeed a certain degree of inter-change among the various settlements in these regions, but these interchanges were not elaborately organised by any central authority as it presumably was in the Harappan society. Here each community remained essentially independent, growing their own foods, having a homogeneous population and only a slight division of labour perhaps. As opposed to this we have seen that in the Harappan culture a stratified society with the indications of a hierarchical order (as evident from architectural remains also) and clear-cut divisions of labour ran the show. House-plans at these Deccan and Central Indian Chalcolithic sites indicate that here the co-habiting units were nuclear families. Here we do not come across Ware-houses or 'coolie-lines'. The organising principle in these societies was kinship rather than class and craft-specialisation as at Harappa.

We have already noted in the previous chapter the hypothetical estimations drawn by M.K. Dhavalikar and

G.L. Possehl on the probable population, area of cultivation, and figure of domestic animal population at the settlement on Inamgaon.[535] Here we would like to just mention their estimated figures in the passing.

They postulate that at Inamgaon, a site of five hectares, populations of approximately 1000 or 650 persons probably lived. They estimated that the daily grain (wheat, rice, jowar) requirement would be 260 Kg. for 650 people and 400 Kg. for 1000 people, which comes to approximately 100,000 and 150,000 Kg. per year. The area required for cultivation of these crops comes to 444 acres for 650 persons and 667 acres for 1000 persons. Vegetables or legumes must have taken additional land. The total land required for each person comes to one acre roughly.[536] Dhavalikar and Possehl refer[537] to Leshnik's estimations here who calculated a figure of approximately 2 acres per person in the Central India.[538] Thus they suggest that using their own figure as the lower limit and that of Leshnik as the upper limit, Inamgaon might have required cultivated lands of somewhere between 650 and 2000 acres, which comes to 0.55 miles and 1 mile of agricultural land in radius around the settlement.[539]

There is a basic difficulty in these regions as to the availability of the river alluvium for cultivation. The large rivers in the central and peninsular India like the Mahanadi, Godavari, Krishna, Narmada and Tapti mainly flow through uplands and not through valleys. They are entrenched and thus cannot spread their fertilizing waters on the countryside till they reach the delta areas.[540]In the area near Inamgaon for example, the Ghod river, entrenched as it was, could have allowed a strip of cultivable land between 200 and 225 feet wide on each side of the river. The calculated estimates just mentioned above indicate that in the circumstances, the black cotton soil adjacent to the site was also farmed as well as the alluvial strips.[541] Therefore, as Leshnik has pointed out, agriculture was dependent

mainly on dry-farming techniques here in these central Indian and Deccan sites. The Black cotton soil, containing rich nutrients, with excellent capacity to absorb and retain great amounts of moisture, can be used repeatedly without its productivity being seriously affected. Leshnik also points out that this soil does not require ploughing. In summer the Black cotton soil losses its moisture and shrinks greatly, leaving deep, gaping cracks, which admits sunshine and air in abundance, and no artificial intervention is required.[542] This is the reason why the Black cotton soil is said to plough itself. However, cultivation in the Black cotton soil could not have been extensive without strong agricultural tools and greater organisation. While the natural qualities of the soil would allow for cultivation of some dry-farming crops on a small-scale, it would be necessary to clear the thickly-covered land and the sticky soil throughout much larger areas than simple tools could accomplish for large-scale cultivation of the staple crops. The people at Inamgaon, as we have noted above, indeed tried their hands at some sort of artificial irrigation. However, the total picture in the Deccan and Central Indian chalcolithic context clearly indicate that there were no large-scale agricultural operations running in these regions. Also the small sizes and low density of the Malwa and Jorwe settelements, requiring low level of productivity, indicate that simple techniques would have sufficed here for cultivation.[543]

SOUTH INDIA

The plant economy of the chalcolithic people at the South Indian sites was almost similar to that of Central Indian and Deccan chalcolithic cultures. We have noted that already in the neolithic context horse gram (*Dolichos* sp.), green gram (*Phaseolu* mungo) were being cultivated and consumed by the people at some of the excavated South Indian sites. The occurrence of the finger millet or ragi (*Eleusine coracana*) at neolithic and neolithic-chalcolithic overlap phases at Tekkalkota and Hallur respectively indicates

that a cereal — legume agriculture had already been adopted by the neolithic farmers further south of the Deccan. The soil was mainly Black cotton and also laterite. The climate was generally tropical. The life-style was not basically different from what it was in the neolithic time, except perhaps the possession and use of a limited copper repertoire. We must note here that not many of the south Indian sites yielded evidences for the chalcolithic cultural context and at many of these sites we encounter the megalithic-iron age culture straight away after the neolithic strata.

BLACK - AND - RED WARE CULTURE

Coming back to northern India, we note the emergence of a new culture, characterised by the Black-and-Red Ware, at some of the sites. It would be interesting to note what developments were being made in the farming economy in the Rajasthan and the Ganges Doab region towards the end of the second millennium and the first half of the first millennium B.C.

From Noh, district Bharatpur, Rajasthan, we have archaeobotanical evidences from the pre-PGW context, characterised by the Black-and-Red Ware. Impression of Spikelets and Kernels of rice were recovered in one of the burnt clay samples from this period.[544] Moreover, several fragmentary cotyledons of *Dolichos biflorus* have been recovered from one of the clay samples from this level.[545] The remains of the black gram, *phaseolus mungo* L. have also come up.[546] This Black-and-red Ware level is dated approximately C 1200-1100 B.C. at Noh.[547]

At Atranjikhera in the Uttar Pradesh there was no basic change in the agricultural economy during the Black-and-red Ware period (C 1400-1200 B.C.) from that of the earlier OCP period. The two cereals, rice and barley, continued to be cultivated.[548]

In Bihar, the site of Sonpur, district Gaya saw the emergence of a Black-and-red Ware cultural settlement,

which may have begun around C 1000 to 700 B.C. Here a large quantity of charred rice was recovered from the debris of a burnt storage jar.[549] The Allchins mention that the cultivation of rice, wheat and barley was being carried out at this site. The people lived in the huts of wattle and daub.[550]

The Allchins point out that in the eastern Ganga Valley a direct sequence from the Black-and-red Ware culture to the NBP Ware culture is noted at many important sites like Sonpur, Buxar, Rajghat, Chirand and Prahladpur. At all these sites the PGW is absent although in the earliest phase of NBP a plain grey Ware is found. The Black-and-red Ware gave way directly to NBP Ware around C 500 B.C.[551]

This part of Ganges Valley, enjoying, as it does, a rain fall of over 100 cm per annum, must anciently have been more densely forested than the doab. For this reason, if for no other, the expansion of settlement most probably had depended on the availability of effective methods of forest clearence. There is at present no indication from which direction the settlers came, as the Allchins point out.[552] It may have been likely that they came from the west and moved eastwards down the Ganges river valley before the pressure of the expanding population associated with the iron using PGW culture. The Allchins suggest that one possible way of charting this expansion would be to document the occurrence of rice in the Ganges Valley, for he points out, during both the periods of PGW and NBP Ware, the growth of population and consequent increase in the number of settlement appear to coincide with a great increase in the cultivation of rice and its growing dominance as a cereal source.[553] This is because this region of the Ganges Valley is suitable for the cultivation of abundant rice.

We have already come across evidences for the cultivation and consumption of rice at neolithic Chirand in

Bihar, Pandu Rajar Dhibi in West Bengal and Baidipur in Orissa. The occurrence of pulses at Chirand indicates that at least in Bihar a mixed-crop cultivation had come into existance in the neolithic time.

Additional evidence for agriculture in the eastern Indian Chalcolithic context comes from Mahisdal, district Birbhum in West Bengal. A large quantity of charred grains of rice was found scattered all over the second floor- level of period I. Moreover burnt husk-impressed clay plasters indicate that the straw or husk was used for building huts.[554] The cultural assemblages include a variety of ceramics, viz., Black-and-red Ware, plain or painted, black-painted red ware, plain red ware etc., some terracotta objects, beads of semi precious stones and steatite and a flat copper-celt with a convex cutting-edge. The people lived in mud huts with reed plastered clay walls and floors of beaten earth.[555] The situation of the settlement, on the north bank of the Kopai river, rising some five metres above the surrounding fields in a region of monsoon rains and a tropical climate was favourable for the cultivation rice, a summer crop.

Thus, we note the emergence of a rice-belt in the eastern Ganges Valley which was associated with the cultural progress in the region during the subsequent PGW and NBP Ware periods as we shall see. Indeed, the stage had to be set for the growing socio-economic progress with a surplus agriculture in the background. In the ecological circumstances of this region, rice had to be the staple cereal which provided the base to that surplus. As we shall note later, the Vedic texts give a high priority to this cereal. But it required a lot of time and energy on the part of the ancient colonisers and settlers in the entire Ganges Valley to build up the required agricultural surplus and this was not achieved before the advent of the Iron Age.

VI
THE IRON AGE AND THE EVIDENCES FROM THE VEDIC LITERATURE

Iron makes its apprearance in the Ganges Valley around the beginning of the First millennium B.C., it might have appeared a little earlier in the north-west of the Indian sub-continent and about the same time as the Ganges Valley at one of the South Indian sites at least, as far as stratigraphical occurrence of iron objects goes. It has long been a matter of much discussion and opinions as to how far the advent of iron metallurgy accelerated agricultural production and brought about socio-economic changes. While a group scholars like Nihar Ranjan Ray,[556] Dilip Chakraborti [557] and R.S. Sharma[558] are of the opinion that at least till the second half of the first millennium B.C., iron technology played no great role in the progress of agricultural economy and the overall economy in general in the Ganges Valley, some scholers like M.D.N. Sahi[559] hold that iron metallurgy had indeed made the progress of agricultural economy easy and rapid leading to intensive agriculture and cultivation of newer crops in the Ganges Valley, around the beginning of the first millennium.

N.R. Ray states that on the basis of the iron objects that have been discovered so far in Punjab, Haryana, Western Uttar Pradesh and the adjoining areas of Rajasthan in the levels belonging to C 800-50 B.C., it cannot be postulated that iron implements were used in handicrafts or agriculture on any considerable scale.[560] He points out that a careful look at the list of iron implements recovered from most sites of this context in these regions shows that by far the larger number of iron implements are those which were presumably used for hunting and warfare.[561] Dilip Chakrabarti puts forward that in no case did iron bring about a noticeable change in the material prosperity of the people, soon after its introduction.[562]

R.S. Sharma is of the opinion that it was from C 600

B.C. onwards to 322 B.C. that a significant change in the economy was taking place, strengthened by the wide-spread use of iron, extensive cultivation of rice, sugar and cotton, and the rise and growth of numerous towns in North-Eastern India.[563]

O.P. Tandon points out that the dawn of the first millennium B.C. still saw the Indian society in pastoral economic age. However, he goes on to quote Marx and Engels remarking that iron made possible field agriculture on a larger scale and the clearing of extensive forest tracts for cultivation. With agriculture becoming a reputable pursuit and agricultural production having increased due to large-scale cultivation in the plains of Doab, the economy obtained a surplus base.[564] The efficiency of the industries were similarly increased. There was a rapid progress made in the fields of transport, trade and civic life. The surplus wealth would lead to the second urbanisation.

M.D.N. Sahi is of the opinion that iron was introduced into the Indo-Gangetic plain by the unpainted Black-and-Red Ware people at Noh. But very soon the technology was mastered and popularised by the Painted Grey Ware people who colonised northern India between C 1100 to 800 B.C.[565]

He goes on to suggest that the hard alluvial soil and deeply forested areas of the Gangetic plain, which posed as handicaps before the chalcolithic people, could now be handled by the PGW people. He points out that perhaps the socketed axes, broken pieces of which were recovered from Hastinapur, and simple type axes from Atranjikhera, Jakhera and Noh were used by the PGW people for cutting the stumps of the burnt down trees of the dense forest, facilitating the reclamation of the land for agricultural purposes.[566] He also points out that the plough-share from Ālamgirpur[567] and those from Jakhera[568] must have been very helpful in breaking the alluvial soil of the Gangetic plain and making the fields for cultivation. Besides, a complete sickle (without

handle) from the proto-PGW levels at Jakhera (period IIA), a smaller one from Atranjikhera (period III) and another from Barudih must also have facilitated agricultural operations. He concludes that, in all likelihood, the newly acquired iron technology was harnessed by the PGW people for overcoming the ecological handicaps and ushering in an era of large scale settlement and agricultural production.[569]

However, the evidences of the presence of iron agricultural implements, especially the plough, is very limited in the PGW levels. Vijay Thakur points out that 'almost all the Northern Black Polish Ware levels have yielded iron hoes, along with sickles, a fact which unmistakably suggests that hoe-cultivation has not been considerably replaced by plough cultivation'.[570] As to the practise of clearing lands, Vijay Thakur states that there are positive evidences that it was in vogue before and around C 700 B.C. (The story of *Satapatha Brāhmana* detailing how *Videgha Mathava* come up to the banks of the river *Sadānirā*) with limited help from copper and bronze axes for this purpose cannot be ruled out.[571]

Yet, we certainly note the beginning of a more orderly and vigorous practice of agriculture as an economy from the Painted Grey Ware phases onwards, although iron technology may not have helped to a great extent. In the Northern Black Polish Ware period, beginning in the C 600 to 500 B.C., we find that the economy was heading towards a surplus production in which perhaps the iron technology played a role. The Vedic textual informations are very enlightening here. The archaeobotanical evidences, on the other hand are not available from many Painted Grey Ware and NBP Ware sites.

The period II levels at Hastinapur (Dist. Meerut, Uttar Pradesh), characterised by the Painted Grey Ware, revealed the occurrence of charred grains, identified as rice, in a pit.[572] The PGW people here lived in houses with reed-walls plastered over with mud, carried on agriculture and cattle

breeding, possessed a metal repertoire, copper being the chief metal, iron slag appearing in the latest levels of this period.[573] Iron implements begin to occur in greater numbers in the subsequent NBP Ware period, among which, an arrow-head, a chisel, a sickle and several nails were present.[574]

Makkhan Lal reports that evidence for the occurrence of rice, barley, pea and an unidentifiable legume has been obtained from the PGW site of Radhan in the Kanpur district.[575] The PGW period at Noh also witnessed the continuation of the rice cultivation.[576]

At Atranjikhera the Painted Grey Ware cultural period (C 1200 - 600 B.C.) saw the appearance of another new cereal at this site, viz., the wheat. Thus, all the three important cereals namely, rice, wheat and barley were now being cultivated and consumed.[577] Of these three cereals, rice appears to have occurred in largest quantity. Wheat and barley came second.[578] Rice remains in the OCP levels (period I) and Black-and-Red Ware levels (period II) occurred mostly with the husk and was found embedded in mud-clods. But in the PGW levels cereals occur not only in mud-clods and wall-plasters but heaps of rice were found at more than one place on the floor and also near what appeared to be a hearth. Moreover, here fifty percent of the rice occurs without husk.[579] K.A. Chowdhury points out that these facts indicate that the production of the cereals was not only enough to meet the requirements of the entire community, but there was also some surplus. Thus the Painted Grey Ware folks had certainly made a great advancement over the OCP and Black-and-Red Ware folks in the agricultural economy.[580]

K.A. Chowdhury however, has raised a pertinent point as to the question of wheat cultivation. He points out that wheat required more water at regular intervals than barley. But he also points out that there is no evidence that some sort of artificial irrigation was practised at Atranjikhera.[581]

However, it is also true that the PGW people here cultivated less of wheat and barley than rice.[582]

The site of Atranjikhera had the river Kali Nadi very near to supply water for drinking as well as agricultural purposes. Vegetation, as K.A. Chowdhury suggests, was probably not dense around the site and must have been between desert thorn to ravine thorn forest with some scrub forest of grass, so that clearing the land for cultivation was not difficult.[583] The fertile soil on the river banks, periodically flooded, would have been excellent for cultivation. Rainfall and temperature were moderate and put no hindrance to agricultural activities. The Northern Black Polish Ware people at Atranjikhera (600-50 B.C.) cultivated all the three cereals mentioned above, with rice constituting ninety eight percent of the entire cereals.[584] Besides they also cultivated a new pulse, *Phaseolus-mungo* [585] or urad which is cultivated only in the winter.[586] Thus, we see that the people at Atranjikhera were preferring rice as a staple food more and more since period III (PGW) and had added the urad pulse to their list of cultivated crops which is at present considered a delicacy among pulses.

The area occupied by the PGW culture in the Ganga Valley is mainly confined to the doab. The climate is sub-humid with cool winters and hot summers. The main physical features are the older alluvium, bhangar and the younger alluvium, *Khadar.* This vast alluvial plain was inhabited by the PGW people who were basically agrarian folks, having mastered the techniques of plant cultivation and cattle breeding. In the Gangetic plains as a whole most of the settlements are located on the larger rivers which were perennial for these provided better economic resources than the small tributaries which carry little or no water during the summer. However, here there was the risk of floods. The Ganga Valley was subjected to periodic severe floods in the past as it is now. Hence, the PGW sites are located on elevated lands to reduce this risk.[587] Farming was practised

on the low-lying areas near rivers and lakes, and the soil was enriched by the deposition of fresh silt by river floods. There was ample pasture land to support domestic herds. The forests further from the river provided games and the river fresh water fish. The cultivation of rice thrived in these conditions. However, as yet the economy was at a subsistence level and there was no significant surplus in the agricultural production to merit urban developments.

But the NBP Ware farmers some centuries later, around C 600-500 B.C. were beginning to penetrate deeper into the forests, clearing the land for cultivation on larger scales, perhaps with the more efficient iron implements, which began to be used in the economic pursuits more and more. As Makkhan Lal points out, the inadequacy of the iron technology available to the PGW constricted the scale of agricultural operations. But these difficulties were overcome by the NBP Ware phase when the foundations were laid for the urbanised civilization of the historic India.[588]

Meanwhile, the Iron Age had also dawned on other parts of the Indian sub-continent. D.K. Chakrabarti points out that evidence of protohistoric use of iron in the north-west of the sub-continent comes only from two areas, viz., the Kachi plains in Baluchistan and the Swat Valley. Iron technology appeared at Pirak, the only reported and excavated Iron Age site in Baluchistan, around C 800 B.C. He also points out that it appeared in the Swat Valley little later than C 1000 B.C. The Cairn-burial sites date much later.[589]

However, at most of these sites, the iron objects were concerned with hunting activities and warfare, as evident from the two winged iron arrow-heads from Pirak,[590] arrow-heads and spear heads from the cairn-burial site of Moghul Ghundai,[591] a large iron sword blade and another damaged weapon of iron from the cairn-burial site of Zangian[592] and so on. The only exceptions are the fragments of an iron pot

at Gatti[593] and an iron fish-hook as well as some fragments of small iron implements from Jiwanri.[594]

At the Swat Valley grave sites we encounter the same situation, viz., spear-head, nails, cheek-bar of horse's harness from Timargarha,[595]spearheads and pins from Loebanr,[596] iron fragments and spear from Butkara II [597] and so on. Only at Katelai do we come across iron axes, [598] although whether these were used for clearing the land for agricultural purposes or for other operations connected with war, hunting and butchering is not at all clear in view of the nature of the total iron assemblage, devoid of any other agricultural implements. However, we have alredy seen that at Ghalighai and Loebanr atleast, a farming people were inhabiting in the neolithic period, cultivating wheat, barley, lentil and peas. But, in the absence of any archaeobotanical evidence for the iron-age levels, we cannot come to any conclusion as to the nature of the agricultural economy in this context.

Meanwhile Iron-Age settlements were sprouting up in the Gujarat (C 1000-100 B.C.).[599] The iron-age context was mostly characterised by the Black-and-Red Ware as well as plain and burnished red ware and so on.[600] Basically small villages like Nagara, Timbarva, Sathod, Kamrej, Kokha, Dhatva sprang up with the early inhabitants living in the huts,[601] practising a mixed herding of cattle, goat and sheep,[602] using a variety of metals, viz., iron, copper, lead, silver and gold,[603] and carrying out cultivation of rice and Kodra, the evidence for the last two foods items coming from the site at Nagara.[604] Moreover, at this site a small section of a bund was exposed in the excavations, which, as R.N. Mohta suggests, may have been used for irrigating rice fields.[605] Over and above this, Mohta points out that the presence of seeds of Lacromina Croix, which grows in the swamp-like fertile land that is admirably suitable for rice cultivation, at Nagara and Tripuri, indicates that here the land was definitely suitable for the cultivation of rice.[606] R.N. Mohta points out that the small village settlements of

the early days of Iron Age in Gujarat gradually grew, along with the development of the economy, into commercial and administrative towns at a later date.[607]

The Iron-Age Megalithic culture dawned in the Vidarbha region around C 700 B.C. The excavated sites of Takalghat, Khapa, Naikund and Mahurjhari near Nagpur yield evidence for the use of Iron metallurgy.[608] Interesting for us are the evidence from Naikund where grains of barley, rice and lentil were salvaged by flotation techniques. S.B. Deo points out that this was the first evidence of the food habits and agricultural economy of the megalithic folks in the north-west Deccan. The people here lived in circular huts and used iron hoes in cultivation of crops.[609]

At the Karnataka site of Hallur iron occurred in the neolithic-chalcolithic and Megalithic overlap phase, dated around C 1000 B.C. But in general the Megalithic culture appeared at other sites much later, the time span for this culture being set by S. Nagaraju and B.K. Gururaja Rao, from C 1000 to 400 B.C.[610] The recovery of sickles and plough coulters as well as rice and ragi grains (the latter we have already noted while dealing with the neolithic-chalcolithic overlap phase) at Kunnattur and Hallur respectively shows that these people were probably dependent largely upon agriculture.[611] We have already noted in the previous chapter that the cattle, goat, sheep, dogs and horses were domesticated in the neolithic-chalcolithic-megalithic phase at Hallur, horses being ascribed to the megalithic folks. Hence, on this evidence it can be assumed that the farming economy that had commenced in a rudimentary manner in the neolithic phase in the South Indian sites may have continued in the megalithic phase also. Only further excavations and detailed reports on archaeobotanical evidences will clear the matter as to the exact situation of the agricultural economy in this context.

The Early Vedic society as depicted in the *Ṛg Veda* was primarily a pastoral one. The pursuit of animal husbandry

was more important and agricultural economy was still in an incipient form. The *Ṛg Veda* informs that the territory occupied by the early Vedic Aryans was situated between the *Krumu* (Kurram), *Gomati* (Gomal) and *Kublia* (Kabul) rivers in the west and the Sindhu group of rivers in the east. This was the situation from approximately C 1500 B.C. to C 1200-1000 B.C., preceding the PGW cultural period.[612] R. S. Sharma is also of the opinion that the Rg Vedic people can not be 'equated with the users of the PGW culture'.[613] For, the Rg Vedic people used neither iron nor glass and cultivated only barley.[614] However, the advantages of practising agriculture in a full-fledged manner was perhaps dawning upon them gradually, for it is in the *Ṛg Veda* that we find a prayer to *Indra* for wide fields, vast treasures, extensive pastures and other riches.[615] The gambler is exhorted to leave his frivolous and degenerating game and take up agriculture : 'Play not with dice : no, cultivate thy corn land. Enjoy the gain, and deem that wealth sufficient'.[616]

We must note here that in C 1500-1200 B.C. the regions of Sind and Punjab already occupied by the Harappans were witnessing a continuing state of the agricultural economy. In these circumstances, the pursuit of a chiefly pastoral economy by the Early Vedic Aryans in almost the same regions indicates that these two cultures co-existed, with a considerable hiatus existing between their economies. Some sort of cultural interaction might have taken place, and an impact of the Harappan agricultural economy on the Early Vedic Pastoralists cannot be ruled out. An exchange of technical know-how commenced. A stanza in the *Ṛg Veda* perhaps refers to the method of clearing land for agriculture, indicating the beginning of the whole process.[617] Its states that the Deities carrying axes approached with attendants splitting the wood. They laid the timber in the fire receivers and burnt the grass up where they found it growing. Griffith mentions[618] that Prof. A. Ludwig also sees in it the beginning of agriculture.[619] Another such reference may be cited in the

Ṛg Veda, Book I, hymn 58 stanza 4. References to ploughing and sowing are forth-coming from *Ṛg Veda*. The *Aśvins*, the twin gods, are praised as Wonder-Workers for ploughing and sowing barley and thus milking out food for men.[620] Thus, there can be no doubt about the appreciation for food cultivation among the Early Vedic folks. The practise of ploughing with steers is also referred to.[621] The authors of the *Ṛg Veda* pray that may Indra press the furrow down, may *Pūṣaṇ* guide its course aright. May the 'Field' personified be drained each succeeding year for the people.[622] Let the shares turn up the plough-land and happily may the ploughers move with their oxen.[623] The plough, the action of ploughing with bulls for harvest is referred to in various hymns.[624] References to the furrow (*Sītā*) personified[625] is made, indicating the relegious significance applied to agricultural operations and production. This along with the prayers for agricultural bounties and appreciation for agricultural works already mentioned above exhibit the realisation of the importance of agriculture.

The Rg Vedic people perhaps cultivated barley for *Yava* for barley is mentioned among the crops in the *Ṛg Veda*. Perhaps the crop was broadcast for there is a reference in the *Ṛg Veda* where the act of strewing down barley out of a winnowing basket is described.[626] In another passage a reference is made to the act of reaping the ripe corn from a field full of barley.[627] The use of sickle to cut the barley and gather it up is also referred to.[628] However, it may have been that the term *Yava* was used in the *Ṛg Veda* to denote not only cultivated barley but also all the crops.[629] The Vedic texts also refer to several terms derived from the term *Yava*. The *Ṛg Veda* mentions a river *Yavyavati*.[630] The *Pañcaviṁśa Brāhmaṇa* also refers to this river later on, whose basin was famous for the production of barley.[631] It may have been that *Yava* was used as a term for all cultivated crops in Rg Vedic period.

As P. C. Basu also points out, from the available materials

in the *Ṛg Veda* "it is difficult to find out the grains that were produced by agriculture". "All the words used for grain" in this text "have had some special meaning in the later periods which was not the meaning in the *Ṛg Veda*". "Probably it was an age during which they had just learnt the cultivation or use of some new products, but which being recent, were not as yet given any special name".[632] However, barley or *Yava* can be identified as most probably to have been cultivated by the Rg Vedic people, for it has been refferred to repeatedly. The fifteenth verse in the hymn 23 of RV Book I refers to the repeated cultivation of *Yava* round the year. Significantly the barley can be cultivated twice a year in the same soil.

Another word repeatedly used in the *Ṛg Veda* to denote grains was *dhāna*. "We find that the same difficulty arises as to the exact significance of the word, so that the people of the time either did not distinguish one kind of grain from another or their distinction was not properly reflected in the nomenclature".[633] However, it could have been that the *dhāna* as it is distinguished today - rice - had been cultivated in the Rg Vedic times. Yet, in the later saṃhitās the rice is given a different name *Vrihi*, which is nowhere referred to in the *Ṛg Veda*. It is in more recent sanskrit that the *dhāna* came to mean rice.[634] Hence, we can not be sure of rice cultivation in the Rg Vedic days as we are about that of *Yava* or barley, a crop that continues to be referred to in the very same name and distinguished as a much cultivated crop.

It is also surprising that the *Ṛg Veda* does not refer to cotton, although the crop must have been cultivated since very early times in the Indus Valley and Gujarat, first occurring at neolithic Mehrgarh. However, as we have seen, the Rg Vedic Aryans, primarily a pastoral folk and not initiated properly to agriculture, may have had nothing to do with the cultivation of cotton. They derived the fabric for their clothes mainly from the wool of sheep and goat. Yet we

find a probable reference to the silk-cotton tree, *Semal* or, as mentioned in the verse, *Śimbala*, in *Ṛg Veda*, 3.53.22. The verse states that, as one cuts off without difficulty the flower of the *Śimbala*, so may the enemy be cut down.[635] It may have been that although the Rg Vedic people did not cultivate cotton, they perhaps knew the use of the cotton-wool that came out of the popping flowers of the silk-cotton tree — *Śimbala* or *Śemal*.

The crop after being reaped by the sickle was gathered and then threshed and winnowed by the Rg Vedic folks.[636] Griffith states that the exact meaning of the word *Sthivibhyah* to denote winnowing basket, is somewhat uncertain. But it is evidently a measure, basket or instrument connected with corn.[637] Wilson renders *Sthivibhyaḥ* in his translation of this stanza as 'from the granaries'.[638] The entire passage mentioned here would mean that the cows bestowed by *Bṛhaspati* are countless as grains of barley on the threshing floor or winnowing-place.[639]

The *Ṛg Veda* informs that the peasants depended mainly upon rain for irrigating the cultivation fields in those days.[640] The hymns of the *Ṛg Veda* dedicated to Parjanya, the God of the rains, and the frogs are clearly intended for rain charms or *mantras*.[641] Prayers were also offered to Varuna for timely rains. The Rg Vedic folks prayed for adequate rains for the production of sufficient grains.[642] River inundation must also have helped cultivation. Besides, wells *avāta*, may have been dug for drinking water as well as irrigation purposes.[643] There is a reference perhaps to water-canals dug probably for irrigation purposes in the *Ṛg Veda*, Book VII, hymn 49, verse 2, viz., 'Waters which come from heaven or those that wander dug from the earth, or flowing free by nature. Bright, purifying, speeding to the Ocean, here let those Waters, Goddesses, protect me'. Here, the phrase — 'those that wander dug from the earth' has been explained by *Sāyana* as *Khanitrama Khananena nivrittah*, that is formed or perhaps stopped by digging

canals or reservoirs.[644] This is a more or less clear reference to irrigation. Significantly, the course of a free, naturally flowing water has been mentioned in the verse side by side to this reference, thus making it clearer that artificial canals are being described here.

The sincerest and heart-felt entreaties to the Indra again and again for the boons of cattle and seeds in the *Ṛg Veda*[645] reflect the increasing need for plant and animal food felt by these simple folks. This also indicates a gradual inculcation of sedentarism in the people who were originally nomadic. The processes of cultural evolution were having their effects on the early Aryans who were already beginning to practise a little bit of agriculture in addition to pastoralism in the early days of the Vedic civilization.

The Later Vedic age (C 1000 - 600 B.C. approximately) saw the graduation of the early Vedic pastoral society into a full-fledged agro-pastoral one from C 1000 - 800 B.C. onwards. A story in the *Satapatha Brāhmaṇa* indicates that the practice of agriculture was one of the causes for the victory of the *Asuras* (indigeneous Indus Valley folks perhaps) over the *Devas* (perhaps the Aryans). The text states that even the foremost of the Asuras were ploughing the fields, sowing seeds and the subordinate ones were engaged in reaping and threshing of the grains.[646] It seems that the necessity for adopting the agricultural economy as well as the bounties that might be derived there-from was gradually becoming more and more clear to these people. The *Atharva Veda* refers to the peasants who were proud of having produced food grains.[647] It also states that these men depend for their livelihood on grains. Such men are successful in the cultivation of their agricultural fields.[648] This transition in the economy is perhaps best reflected in the much later text of *Mahabharata*[649] where *Bhisma* explains how the first territorial states emerged. It is told that *Viṣṇu* in order to create political balance cleanses the spirit of the King *Vena* by freeing his body of the presence of *Nisāda* who was

expelled to the forest. *Niṣāda* represents the stage of hunting-gathering. This element is then replaced by *Pṛthu* who, the text says, initiated agriculture, pleased the Brahmanas and the people and was called '*rājā*.

In the early days of the Vedic civilization in the Indian sub-continent when the Vedic folks roamed about from place to place they had no permanent settlements. But gradually they began to occupy some areas and called these areas *Kṣetra*, or place of dwelling.[650] Prayers were offered to the *Kṣetrapati* (the God of the fields or settlement) for protecting the Kine and horses.[651] This indicates that the settlement was surrounded by pastures. Gradually, as the technique of agriculture was taken up the settlements began to be selected on the basis of availability of land suitable for cultivation. So the cultivation fields around the settlements also began to be termed *Kṣetra*.[652] Moreover lands were distinguished according to their qualities. *Urvarā* was the fertile land as opposed to *anurvarā* or barren land.[653] More elaborate connections of the term *Kṣetra* was found in the *Atharva Veda* and *Chāndogya Upaniṣad*, where it is used in the sense of the farm-land carefully measured and protected.[654] This indicates that a generally organised way of farming had evolved by this time and that perhaps the system of separate land-holdings existed.

We have already seen that land was cleared for cultivation by setting fire in the Rg Vedic times. The same practice continued in the Later Vedic days also. The *Śatapatha Brāhmaṇa* informs that even before this text was compiled the region between the river *Sarasvatī* and the river *Śadānirā* was covered with forests which were burnt down by *Videgha Māthava* as he approached the banks of the latter river with his priest *Gautama Rāhugaṇa*.[655] This text also mentions that the *Brāhmaṇas* did not cross the *Sadānīrā* because the region to its east was not Aryanised and it was also not cultivable as it was marshy.[656] But later the situation changed and the region to the east of the river

Sadānirā was reclaimed for cultivation and was Aryanised.[657] The *Taittirīya Saṁhitā* also informs that forest was burnt down only to be reclaimed for cultivation or settlement, otherwise it was left untouched.[658] The axes were perhaps used for cutting down trees in a limited manner. We have already noted that iron axes were very few among the PGW metal assemblages. Copper and bronze axes were not very effective in cutting down the large trees growing in the deciduous forests in the Ganga Valley. However, the *Śatapatha Brāhmaṇa* refers to this implement as *Svadhiti*, a symbol of a pioneer which was prescribed not to cut down certain kinds of wood.[659]

The Later Vedic people cultivated a number of clearly distinguished crops as against the lone examples of barley in the Rg Vedic context. We must remember that throughout the early and later Vedic times the Aryans were moving further and further east from the regions of the seven rivers, the Indus, the five rivers of the Punjab viz., *Vitastā*, *Asikni*, *Parusni*, *Vipās*, *Sutudri* and the *Sarasvatī*,[660] towards the valleys of the *Gāngā* and *Yamunā*. The wide and varied eco-geographical area they had begun to traverse and occupy was being reflected in the different varieties of crops they had begun to cultivate in the Later Vedic times as the texts indicate. We may also note that the PGW sites yielded evidences for the presence of some of these crops. Perhaps further excavations will yeild more definite evidences corelating the agricultural economy as gleaned from the Later Vedic texts and the PGW sites.

We have already seen that *Yava* or barley was the only crop clearly mentioned in the *Ṛg Veda* to have been cultivated. However, it may have been that the Rg Vedic people had the name *Yava* and *dhānya* for all the crops they cultivated. The Later Vedic texts, on the other hand, mention a lot of crops by different names. From the later Saṁhitās onwards, *Yava* has been used in the strict sense of barley grain.[661] The stalks of barley, tawny brown in colour with

silvery ears attracted the composers of the *Taittirīya Samhita*.[662] In comparison with other cereals the barley was considered to be more moist and sturdy.[663] The Vedic texts mention mainly two varieties of barley, viz., *Govidhūka* a wild variety grown in the rainy season, much liked by the animals, hence the name — *Govidhūka*;[664] *Upavaka* was another variety[665] which was later termed *Indrayava*.[666] It formed an essential constituent of gruels.[667] Barley and rice were definitely very important to the diet of the later Vedic people for they have been mentioned as two sons of *Prajāpati*.[668]

The later Vedic texts refer to several varieties of rice (*Vrihi*). *Kṛṣṇavrīhi* is black rice or paddy,[669] *Śuklavrīhi* or white paddy.[670] These two were common varieties. *Āśundhānya* was a quickly growing variety of rice.[671] *Hāyana* was a variety which took a year to ripe and had a red husk.[672] *Nivāra* was a wide variety growing in shallow marshes.[673] *Mahāvrīhi* was the most important variety of rice.[674] It has been regarded as *Samrāt* among the grains.[675] The *Mahāvrīhi* also signified political sovereignty thus indicating the high economic status this cereal had.[676] Although the Vedic sources do not give us the exact region where this cereal was cultivated, *Patañjali* much later informs us that it was produced mainly in Magadha.[677] It may have been that this cereal was cultivated in the central Ganges doab when the Vedic people colonised this region in the later vedic period. It should also be noted that rice was used most often as sacrificial oblation[678] sometimes along with barley as *havi*.[679]

Wheat, *godhūma* however, had no sacrificial significance. The *Ṛg Veda* does not mention *godhūma*. However, as we know, wheat was being vigorously cultivated in the Punjab and Sind since the Harappan times. Hence, it is a wonder that atleast this cereal, which was more common than rice in these regions around the time of the Aryan advent, should not be referred to in the *Ṛg Veda*. This omission may either

be referred to the fact that the early Vedic folks did not or could not cultivate the cereal or that they preferred barley to wheat which they considered a staple food of the Asuras or Harappans and hence did not even mention it. However, the later Samhitas[680] and brahmana texts[681] refer to the *Godhuma* frequently.

Among the pulses the *māsa* was cultivated and consumed by the later vedic people. Different kind of preparations made of this pulse and *tila* were offered to the Gods as oblations.[682] But the *Kāthaka Saṁhita* and *Maitrāyanī Saṁhitā* prohibit the use of *māṣa* for sacrificial purposes.[683] This crop was described as sown during the *hemanta* (autumn) and harvested in *sisira* (winter).[684] Its inferior variety was consumed by the poor.[685] The cultivation of this seasonal crop indicates that the techniques of selected crop cultivation and crop rotation may have been in vogue in the later vedic society.

Tila, sesamum, has been referred to in several contexts in the later Samhitas and Brahmanas, as commonly used in sacrifices.[686] Paddy and sesamum have been compared with cow and the calf, respectively.[687] This indicates the prime importance accorded to these crops for, as we know, the cattle was a prize beast to the Vedic Aryans. The sesamum had two varieties, a wild and a cultivated one.[688] The *Śatapatha Brāhmaṇa* and the *Taittirīya Saṁhitā* distinguishes a wild variety of sesamum called *Jartika* which was used in preparing porridge,[689] indicating that a cultivated one was also in existence. *Tilodāna*, a preparation of sesamum and rice boiled in water is mentioned in the *Bṛhadāraṇyaka Upaniṣad* and *Saṅkāyana Āranyaka*.[690] We also learn from the *Atharva Veda* that sesamum stalks called *Tila-pinja*, were used as fuel.[691] The sesamun oil is mentioned in the same text as well as in Śaṅkhāyana Āraṇyaka.[692]

The *Vājasáneyi Saṁhitā* mentions the *mudga* pulse and bean in the list of vegetables.[693] A preparation of rice and *mudga* bean, *mudgaudana*, was quite popular.[694]

Khalva or gram is mentioned as a sacred grain.[695] It was also consumed as a pulse.[696]

Priyaṅgu was an inferior quality of cereal[697] which may be identified with *Setaria Italica* or millet. On the occasion of royal consecretion its sprouts were placed on the head of the *Ksatriya* or the King.[698] *Anu*[699] and *Śyāmāka*[700] denote a variety of grains of small sizes. *Śyāmāka* is particularly mentioned as very light in weight and small in size so that the term *Śyāmāka* was used as a simile to indicate the lightness of things.[701] Another of its characteristic was speedy growth of its plants.[702] Its grains were boiled with water and eaten by the people.[703] This group of crops may be identified as millets.

Among the above-mentioned crops, the *tila* and *Śyāmāka*, i,e., sesamum and millets have not been so far recovered from any of the excavated PGW or NBP sites. However, further excavations may yield evidences for the occurrence of these crops in these context.

It should be noted that even the Later Vedic texts do not mention cotton. It was for the first time mentioned in the *Aśvālāyana Sraūta Śūtra*.[704] But a new crop is mentioned in the Later Vedic texts, viz., suger-cane or *Iksu*, that has to-day attained the position of a cash-crop. *Iksu* has been mentioned for the first time in the *Atharva Veda* as a symbol of sweetness.[705] It appears that originally it grew wild, but for the first time King *Ikṣvāku* of Ayodhyā cultivated it and improved the technique of its cultivation.[706] Fresh juice from it was favourite drink of the people and could be used as a sweetener also.

We have already noted how the Rg Vedic peasants prayed for rains for a good crop. The Vedic settlements, early and later, were located in regions well-watered by various rivers. In the early days the seven rivers Sindhu, *Vitastā*, *Vipāś*, *Śatadrū*, *Asikni*, *Paruṣṇī* and *Sarasvatī* had provided water and alluvial soil to the Vedic settlements in their valleys. But as the Vedic people progressed eastwards

the *Gangā*, *Yamunā*, *Sadānirā*, *Kauśiki*, *Sarayū* and the *Śoṇa* supplied the Vedic settlers on their valley with the necessary drinking water and moisture for cultivation. Perhaps dams were also built to restrain the flow of river water and use it for irrigation purposes. Nirukta mentions *rodhas* as a dam.[707] *Khanitri* [708] denoted all the artificial means of obtaining water, from wells, tanks and ponds to canals and lakes. The later Vedic texts distinguish different varities of tanks or lakes. *Hrada* was a big tank or lake.[709] *Vesanta* was a lake smaller than a *Hrada* but quite big.[710] *Vesanti* was a tank of still smaller in size.[711] The *Atharva Veda* refer to *Kulya*, an artificial water canal flowing into a reservoir.[712] Allegories referring to canal as a calf and the river as a cow indicate that rivers were sources of canals.[713] Rituals were performed on the eve of the opening ceremony of letting out the river waters to flow through the canals.[714]

The Vedic farmers used ploughs to cultivate the fields. It was generally made of hard wood like *udumbara* and *khadira* so that the land could be easily ploughed.[715] The *Śatapatha Brāhmaṇa* compare the plough share made of *khadira* or *kattha* to bones on account of its hardness.[716] *Sīra* (plough) was itself considered as the embodiment of food and ploughing of the sacrificial ground by it was regarded as an offering of food to Agni.[717] The plough (*Sīra*) was attached to pole (*Isā*) and a Yoke (*Yuga*) was attached to it at its upper side.[718] The latter Vedic text speak of four, six, eight, twelve, and even of twenty-four oxen being yoked to the plough.[719] Although generally the plough-share was made of some hard wood like *Khadira*, yet in the Vedic texts the plough is also described as *paviravant*[720] or *pavarivam*,[721] which is interpreted as having a metal share like that of lance. The *Śatapatha Brāhmaṇa* also state that the plough was fitted with a metal tip.[722] R.S. Sharma also assumes that possibly an iron share was used.[723] The recent identification of sanskrit words like lāngalam or plough, udūkhala or mortar and khala or threshing floor as loan

words from non-Aryan languages[724] is extremely significant. This indicates not only an early contact between the Vedic Aryans and the non-Aryans in their vicinity, but also imply the absorption of the specialised techniques of agriculture on the part of Vedic people from their non-Aryan neighbours who were already practising agriculture. A study in this direction might reveal much on the lines of diffusion of technical knowledge at inter-cultural levels.

The first ploughing of the season was inaugurated amidst rituals. In such a ritual, viz., *lāṇgalaṃyajña*, curds, rice fried grains and other things were offered to the gods and the bullocks were fed with honey and ghee.[725] The *Śatapatha Brāhmaṇa* mentions that furrow is like the womb in which seeds are sown, and if one casts seed into unploughed field, it would be like sowing seeds in any place other than the womb.[726] Hence, there can be no doubt about the awareness among the Later Vedic people of the importance of cultivating in plouged fields. Prayers were offered to the gods for enabling the ploughshare (*Phāla*) to plough the land properly and the tillers to ply rightly with their oxen.[727] The ploughshare made of *Khadira* was asked in prayer to confer cows, goats, children and grain on the people.[728] The Vedic Aryans were well acquainted with the utility of cow dung. Since it charged the soil with sap, it was collected for manuring the fields for greater productivity.[729] The term for manure was *purıṣam* which has been derived from the root *pṛ*, meaning to fill.[730]

Before sowing the crop on a ploughed and manured field, prayers were offered to the gods, viz., the *Kṣetrapati*, *Soma* (god of plants), Pūśaṇ, and Indra for letting out tender shoots and growth of plants and providing a bounteous yield of grains.[731] *Sitāyajña* was performed on a ploughed field to secure protection of crops.[732]

In the course of a year two crops were harvested in the same field.[733] The standing crops were harvested with sickles (*dantyā*).[734] Perhaps in the beginning the sickles

were made of animal bones. The *Bharadvāja Śrauta Sutra* states that the *darbha* grass to be used in the *Somayajña* should be cut with a sickle made of the rib of either a horse or a bull.[735] However, later on, sickles of metals were definitely in use as evident from the presence of iron sickle blade from Hastinapur period III.[736]

The harvested crop was collected in bundles.[737] Smaller bundles were beaten out on the floor for seperating grains from plants.[738] Then with the help of the winnowing basket (*sūrpa*) grains were seperated from chaff. The winnower was known as *dhānyakṛta*.[739]

We have noted that the Harappans stored their grains in huge, sophisticatedly built granaries. The Vedic people, simple rural folks, had no such elaborate measure for storing as yet. The Vedic folks stored grain in bushels or *Sthivi*.[740] and a person who possessed several such *Sthivis* was known as *sthivimant*.[741] Barley has been mentioned as coming out of a *Sthivi*.[742] *Urdaraṃ* and *Kṛdaraṃ* were also used for storage. These were probably earthen jars.[743] The *Śatapatha Brāhmaṇa* informs that besides earthen jars, grains were also stored in leather bags as well as jars made of wood.[744]

Thus, we find that the society depicted in the Vedic texts was still basically a farming-pastoral one which was gradually progressing from simple rural stage to a more organised one, politically and economically, when the villages were being grouped into larger units under leaders. The socio-political units of the *Sabhā* and *Samiti* had been organised. The *Samiti* played a role in the military aspect of the vedic society.[745] The *Sabhā* had an economic function. It had some functions related to revenue.[746] The position of the King as the ruler of the people was becoming more and more clear. A number of officials like the *grāmani*,[747] *Sūta*[748] etc. had been organised. Craft specialisation is indicated in the references to the persons of different occupations like the *takṣaṇ*[749] (carpenter), *rathakāra*[750] (officers in charge of

making and maintaining chariots), *Karmāra*[751] (black smith and copper smith) etc. The *Varnāśrama* or four-fold casts system had already evolved, which was closely related to the Vedic economic organisation.

Taxation was a remarkable development of the later Vedic period, when territorial kingdoms were being established. The *Aitareya Brāhmaṇa* states ; 'The king drinking *Soma* in a certain sacrifice is placed in fortune and shines everywhere like the sun. From all directions he exacts tribute, his kingdom becomes stronger and he is not to be shaken'.[752] Whatever belonged to the people the king had a share in them.[753] This actually marks the beginnings of a conscious evaluation of land and its resources. When the taxes became a regular feature,it was realised that some rules and regulations should be formulated. *Uddālaka* for the first time lays down such rules in the *Atharva Veda*. According to *Uddālaka* the amount of taxes realised from the subjects is not the personal possession of the king for his enjoyment. The aim of taxation is to protect and nourish the people.[754] *Uddālaka* further suggests that financial resources are essential for protecting and nourishing the subjects.[755] The Vedic texts inform us that mainly three kinds of taxes were in vogue, viz., *bali, bhāga and śulka* which were realised by the king. It appeares that bali was a voluntary tax, the rate of which might not have been fixed. Mostly it was a tribute paid to the king[756] or an offering to the god.[757] The victors raised *bali* from the defeated kings in order to prove their political superiority.[758] But what is of more interest to us is *bhāga*. The term is derived from the root *bhaj*, meaning to distribute or divide.[759] The people engaged in productive activities had to give the king some shares of their produce. The Dharma Sūtras, later, throw considerable light on *bhāga* . They state that the king should realise that one-sixth of the total produce of food grain, meat, honey, ghee, herbs, flowers, perfumes, roots, fruits, wood, hide and objects made of bamboo.[760]

However, the above picture of taxation in the Vedic texts indicate that an order had been organised with the State authority at the head of that order. The development of the institutions of caste, *Sabhā and Samiti*, craft-specialisation,taxation, and above all the organisation of the political order under a leader or king who was charged with the protection of the people and was dependent on the people for finances and food, were all marks of a great advancement from the socio-economic and political stand-points. It appears that the life in the Vedic context had approached that stage from where the second urbanisation of India would take-off. Basic to all these was the technology which aided the agro-pastoral economy to generate an air of affluence in the total economic structure. Handicrafts could now develop with a vigour and commerce in crafts as well as food grains and live stock was rapidly growing by the NBP Ware period (sixth century B.C.), facilitated by a developed mode of transport provided chiefly by caravans of cattle, horses, mules and asses. As R.S. Sharma points out, towards the end of the PGW period a somewhat proto-urban society was emerging.[763] In the NBP Ware period it assumed a more sophisticated appearance and around C 600 - 500 B.C. the semi-urban *jana* states like those of *Kāsī*, *Kosala* or *Avanti* were emerging.[764]

Throughout, the above study we have noted that the conditions of agricultural economy guided the cultural development in all the contexts in our period in the Indian sub-continent. The pattern of location of sites in each major cultural context in our paper illustrate this point best. All through we have noted how the factor of water-resources (not only for drinking purposes but for irrigation of cultivated fields) influenced the matter of settlement pattern. Each eco-geographical setting presented its own peculiarities, advantages and disadvantages to the settlers. In all the periods, it was primarily the farming folks, who, since the pre-Harappan times, had, in each context, eked out a niche

for themselves and their occupation in each situation. The question was not only how advantageous the natural settings were for the development of a farming technology, the question was how far the primitive farming folks were ready to go in order to maintain and develop further agricultural economy. The attempts at agriculture had begun early in the neolithic days in our sub-continent. Mehrgarh and Koldihwa provide bright examples of independent attempts at plant domestication in two different geographical regions. Thereafter, although there is a temporal gap in the sequence of direct evidences for agriculture in our sub-continent, we can not definitely say that experimentation in farming had ceased. In fact at Mehrgarh we get a continuous evolution of the cultural developments. The development of farming technology is evident in the continued experiments made with cereals like barley and wheat at this site. The selection of the two cultigens as ideal in the ecological and climatic conditions of the region came after such experiments. The farmers came up with different varities of one cultigen species. The transition from naked barley to hulled barley, for example, is a definite sign of technological advancement. It ascertained safer harvesting. Again the selection of six-raw barley indicate a deliberate option made for a more productive variety. The gradual adoption of a hexaploid wheat variety replacing a small-seeded and less productive Triticum durum is another development. Such experimentations are difficult to find elsewhere due to lack of scientific evaluation of excavated data. However, the above evidence do suggest a progressive development of technology. The neolithic cultures of the north and south India were late in appearing but they have provided informations which reflect that cereal and even pulses and legumes had begun to be cultivated in both the regions. Here, the cultivation of millets pose an interesting problem a detailed study of which may open up new vistas in the history of cultural contacts between India and other countries. The eastern region is comparatively poor in such evidences,

the only informations of cereal farming coming from some sites in Bihar, Orissa and West Bengal. Further excavations may fill in these gaps in our knowledge.The probability of practice of 'Jhum' or shifting cultivation, however, definitely indicate the local farmers' successful adaptation to the available conditions as best as they could.

At the end of the neolithic and by the middle of the chalcolithic age in the Indian sub-continent we find a pattern emerging as to the farming economy. Three different regions could be distinguished on the basis of crops cultivated, viz., (a) The region of Wheat Culture : mainly north-west and northern India; (b) The region of Rice Culture : the Ganges-Yamuna doab, central and eastern India; (c) The region of the Millet Culture : the Deccan and south India.

Around the fourth-third millennium B.C. the pre-Harappan folks in the Baluchistan and Sind were heading towards a more developed cultural situation.These people were learning to master the natural environments and exploit the natural resources near at hand. The evidences of irrigational activities reflect these developments. The ecological setting in Sind and South Baluchistan facilitated large-scale agriculture. As D.D. Kosambi had pointed out, the semi-desert vegetational condition in these regions "made real agriculture, yielding a substantial surplus, possible as well as necessary". He stated that, "the common factor of the earliest riparian urban cultures is that the rivers concerned flow through a desert. The desert was necessary because there was no heavy forests to clear".[765] Our discussions above have shown that infact, agriculture in the Harappan milieu was an extremely difficult, labor-intensive operation. It required considerable skill to master the situation, especially that of irrigation which mainly comprised well irrigation. The requirement for physical labor entailed a heavy dependence on animal energy. This naturally called for making certain that enough fodder was available. Chances are high that the inclusion of jowar and bajra in the later

taxa of Harappa food cultivation reflects this demand for cattle in agriculture. The varied ecological settings that fell within the scope of Harappan cultural borders also made it necessary for farmers in different terrains to experiment with and select defferent cultigens suitable in those terrains. Hence within the broad framework of crop regions already emerging in early chalcolithic days, there were innumerable regional variations - in crop taxa, in land selection, management of irrigation and deputing of labour. All this entailed a considerable amount of development in the farming technology. It is clear that each such ecological setting as pertaining to Sind, Baluchistan, Western Punjab, Rajasthan and even south-east Afghanistan witnessed the farmer-settlers achieving an early start on the way to large-scale agricultural heading on to a surplus production. And this lay at the base of the glory of the urban civilisation of the Mature Harappan times.

By the Mature Harappan days the people in the Sind, Punjab, Rajasthan and Gujarat saw the development of a multi-crop farming economy, aided by quite efficient modes of irrigation, by the standards of the time. The early inclusion of cotton, gossypium, in the list of cultigens is indicative of the development of cash-cropping and market operations. The organisational structure was available for the efficient handling of a large surplus production. The growth of urbanity and a metropolitan administration was largely dependent on this surplus agricultural production. But, on the other hand, the administrative machinery was largely responsible for the efficient handling of such large-scale agricultural operations, starting from irrigation to collection, store and distribution of food crops, that upheld the total fabric of the society and economy. There is no doubt that the existence of a large agriculture surplus played an important role in generating the processes of urban development in case of the Indus and later the Ganges valleys. Compared to these cultural contexts, the chalcolithics cultures in Central

India and Deccan attained only moderate heights of achievement. Here also we find a multicrop agricultural economy, an adequate reserve of live-stock and a copper metallurgy. But this copper inventory was quite in significant compared to that of the Harappans. Moreover, the chalcolithic folks here were not inhibiting the river plains in the Sind, Punjab, Rajasthan or Gujarat where scrub forests did not pose much problem before the settlers and cultivation-fields could easily be prepared. The sticky Black Cotton soil and the more dense vegetation in these regions proved to be a difficult situation to the farmers here, equipped with the poor copper metallurgy. Moreover, the major perennial rivers were entrenched here, as we have noted earlier, and provided only narrow alluvial strips for cultivation. No substantial irrigation could be effected in the circumstances. No large agricultural scale surplus was possible at least in the chalcolithic Age. Hence these regions did not witness the major cultural break-through into urbanity untill much later in the Iron Age, as in the case of the cultural development in the Ganges-Yamuna doab. However, here at the Central and Western Indian sites we note an interesting diversification in crop selection. Various species of lentils and pulses had been cultivated by the farmers. Linseed and other oilseeds were also included in the list. Barley, wheat and rice were present and jowar was also introduced. The need to select locally productive species led to attempts at mastering the details regarding these new crops. The inclusion of locally available fruits in the diet might have led to gradual adoptation of these by peasants in their economy. The nature of cultivation techniques at these primarily rural settlements was very different from that known to Harappan farmers. The handling of the soil conditions and availability of water — both river and rain — for cultivation, imposed conditions or restrictions on their activity. Technically, the farmers here and the farmers in the Deccan and Southern India shared similar problems and conditions. Thus these cultures provide

us with a distinct and interesting technological and economic variation in protohistory.

What appears clearly before us is the prime importance of a stable and flourishing agropastoral economy for any cultural development progressing towards the urban experience in this sub-continent. This is evident in the sixth century B.C. context in the region of Ganga-Yamuna doab and the valley at large. We are fortunate in the existence of the Vedic literature which provide us a large volume of information about the socio-economic conditions of the region of upper to middle Ganga Valley in a broad temporal span, from approximately the second half of the second millennium to the sixth century B.C. The highlights of farming technique achieved by peasants in this context indude a completion of the adoption of plough — cultivation most probably with an iron-share by the end of the period ; a mastering of the know-how regarding climate, ecology and soil conditions ; a regularisation of that knowledge through compilation, nomenclature and partial ritualisation ; diversification in crop selection ; categorisation of crop varieties according to quality and productivity ; and finally, most important, the successful selection and adoption of rice as the staple cultigen which proved to be the wisest choice in the circumstances. This last crop, almost doubtly productive than wheat in the ecological conditions of upper to middle Ganga Valley definitely gave a spurt to the already flourishing agricultural production. The techniques mastered by peasants in this context brought about a multi-crop, organised agricultural sector. The basis for a land-economy was created on which rested the nascent organ of state-society, preoccupied with creating a revenue basis for itself. Land and its product provided that basis and hence production on land was the chief concern. In this development, the positive role of the metal iron cannot be dismissed, especially from the sixth century B.C. onwards.

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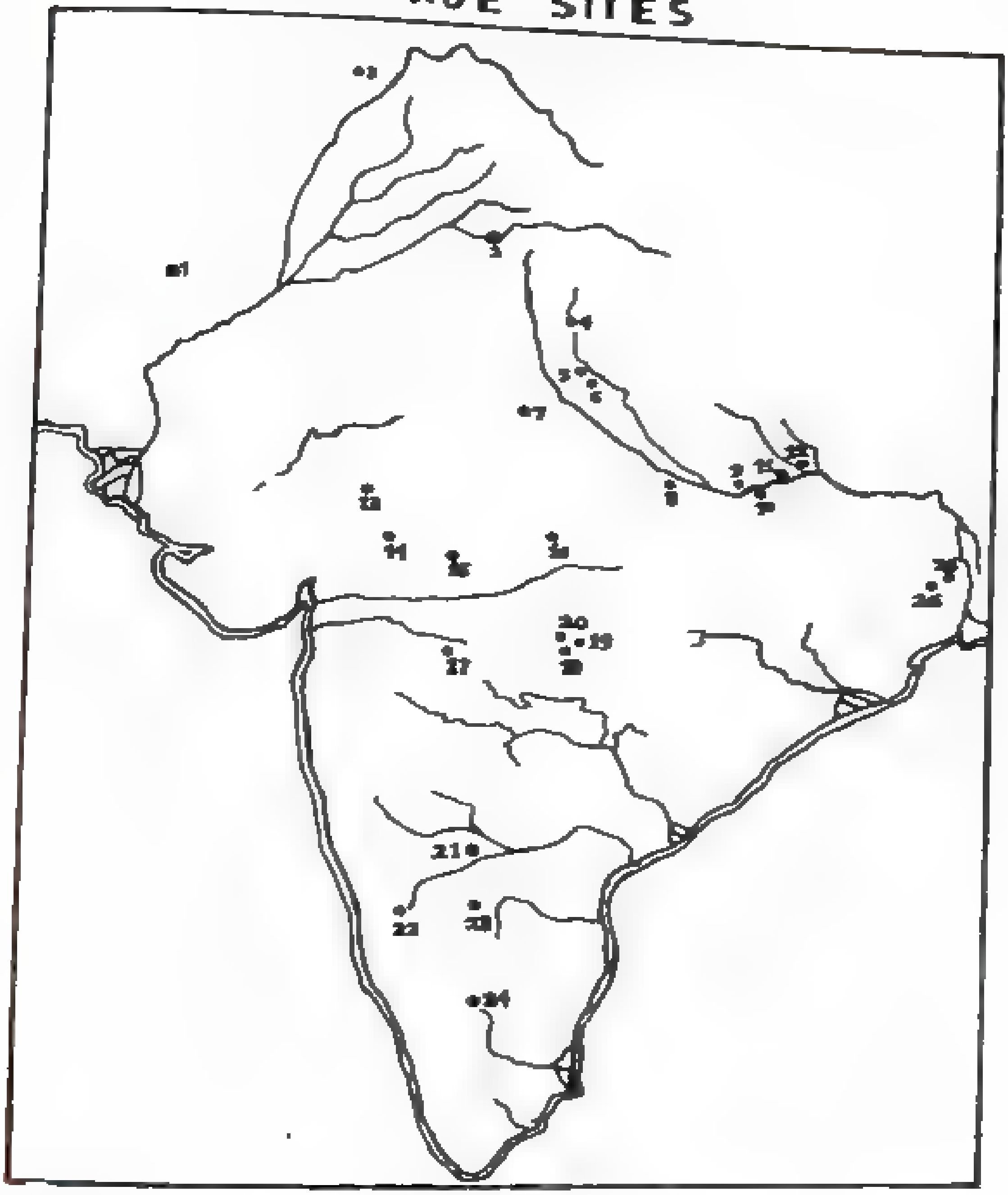

MAP - XIII

KEY-

1 PIRAK
2 RUPAR
3 TIMARGARHA
4 HASTINAPUR
5 JAKHERA
6 ATRANJIKHERA
7 NOH
8 KAUSAMBI
9 RAJGHAT
10 PRAHLADPUR
11 BUXAR
12 CHIRAND
13 ANAR
14 NAGDA
15 UJJAIN
16 ERAN
17 PRAKASH
18 TAKALGHAT
19 MAHURJHARI
20 NAIKUND
21 MASKI
22 HALLUR
23 BRAHMAGIRI
24 T NARSIPUR
25 MAHISDAL
26 PANDU RAJAR DHIBI

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671. JB, 1.43 ; CHU, 5 10.6.
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673. SB, 5.3.3.6.
674. KS, 12 4 ; MS, 3.4.10 ; VS, 18.12.
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694. VS, 18.12
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CHAPTER III

METALLURGY - METALS AND METAL WORKS

Innovations, the basis of cultural changes, have been made by man from prehistoric times onwards. The role of technology in the greater fabric of economic developments is a unique one. It is the hub that rolls and sets the wheel of economic progress rotating. We shall now see the invention of metallurgy leading man to newer cultural developments.

Man has been in the need for tools from the earliest days when he required club, maces, sling-balls etc., to kill games for food, scrap out the skin of a dead animal which was to be used as garment, and to cut woods for fire. The ready raw material, near at hand, was primarily stone. The time span from the Palaeolithic days to the Neolithic saw man experimenting with stones in order to come up with more and more efficient and utilitarian tools and weapons for his daily use. His dependence on such tools and weapons was increasing each day. The time came when he required more efficaceous raw materials.

Metals first became familiar to man as rocks in the area where he lived, an environment with which he was intimately involved for survival and for expression of his social and religious ideas. Certain properties of metal-bearing rocks, such as colour, lustre and weight perhaps made them attractive for collection and use in natural state. It is probable that gradually man realised that heat made some lithic materials, such as flints and cherts, easier to work, and when he applied this technological knowledge to metallic rocks he discovered that some rocks, like native copper, could be formed into serviceable tools through a sequence of hammering and heating. Continued experimentation in heating rocks eventually revealed that certain blue and green stones (azurite and malachite) could yield liquid metal when

the stones were heated sufficiently with charcoal and the liquid metal could be cast into shape.[1] Thus man gained greater flexibility in the fabrication of tools, weapons, ornaments, and statuary etc.

The advent of metal, having distinct advantages over stone, bone or wood for making implements, has been major break — through in man's technological progress. As D.P. Agrawal points out, "the role of metal in the process of urbanisation needs no emphasis".[2] The properties of metals which were important to ancient man were those that he could perceive with his senses. These properties were the ones which made metals valuable and which could be consciously utilized. The properties of the eight metals, iron, copper, arsenic, tin, silver, gold, lead and mercury, the only ones that have been reconised and used as metals before the 18th. centuary A.D., had the following qualities which appeared significant to the ancient metallurgists.[3]

1. The colour of metals largely determined their value. The alteration of colour through combinations of metals and through surface patination must also have been an intriguing property.

2. The lustre of metals, from rapidly darkening iron to everlustrous gold, was at some points in the past a determining factor in value.

3. The ability of bronze to reflect light was an attribute exploited in the production of polished bronze mirrors in some cases.

4. The case with which molten metal can be cast into a variety of intricate forms was appealing.

5. In the technical sphere, the hardness, and sharpness of some metals made them interesting to ancient smiths.

6. The strength and malleability of some metals permitted them to be used effectively in the manufacturing of certain tools and weapons.

7. The ability of metals to be recycled through remelting

and refarbrication gave them a stable value because even broken metal objects still had a use in primitive economics.

The metals used in greatest quantity, copper and iron, in man's pre and protohistory, set the ball of techno-cultural progress rolling and ushered in first, the Copper-Bronze Age in the Indian sub-continent and the Iron Age subsequently.

But in order to achieve maximum value, these metals required a lot of processing and metallurgical techniques before their large-scale adoption in society and economy could take place. Firstly, they must be extracted from minerals by thermal means. The need for thermal conversion indicate the great value that these metals must have assumed in at least some of the primitive economics, for, the time and energy required to achieve the proper environment for melting and smelting were enormous. Charcoal production for examples, meant that wood, brush, or dung had to be collected and prepared. The melting or smelting process required that ore be mined or picked up and useless materials had to be removed. Furnaces and crucibles had to be built. Thus even on a small scale the production of metal demanded greater effort than flint knapping or bone cutting. The beginning of metallurgy therefore is necessarily preceded by a lot of organisation in the sphere of crafts-handling ; a knowledge of heating to a high thermal degree ; the knowledge of the use of metals and extraction of metals ; and over and above all, it required a socio-economic situation where crafts-specialisation and division of labour was practicable. Metallurgy requirèd whole-time involvement, through specialised know-how, and a lot of practical experiences in which failures and successes were regular features in the early days of metallurgy. It is obvious, therefore, that a flourishing food-economy would have to precede before large-scale metallurgy operations could be effectively handled. It is only when man is partially freed from the worries of every-day food requirements and had achieved a degree reliable food supply that he could turn his attention to such

sophisticated crafts as the metal works, that required a total involvement of time and energy on the part of the craftsmen. Hence, it was the farmers of the neolithic and early chalcolithic days who provided an atmosphere amenable for the development of the metal crafts. On the other hand, in the sphere of handicrafts, the ceramic industry, that had already preceded the discovery and use of metals, had prepared the background for the development of further crafts by providing the working conditions, a set of craftsmen, and the firing techniques in the kilns. The ceramic industries provided the basic footing to the whole set-up of the handicrafts and especially metallurgy in the ancient times. The manufacture of pottery, especially the firing techniques, introduced early man to the world of the furnaces. H.D. Coghlan has suggested a connection between advanced pottery kilns and the development of metallurgy.[4] C.C. Lamberg-Karlovsky points out that during the Ubaid period kilns were built and used which produced temperatures sufficient for melting copper.[5] Just as firing temperatures played a significant role in the development of melting, the pottery kiln might also have played a significant role in the development of the smelting ores. As lamberg-Karlovsky points out, during the Uruk period the 'Smother-Kiln' was introduced and utillised for the production of dark-faced wares. The atmosphere in such a Kiln is reducing or oxidising, which leads to smelting of the metallic ore. The importance of this kind of Kiln was far-reaching for the same even could be used by the potter for producing a grey ware as well as for reduction of metal from the ore. We may note here that the necessary temperature for reduction of carbonate or oxide copper ores lies between 700-800°C, whereas, melting of copper ore required 1083°C.[6] Thus we find that the artisans even in the early copper-bronze age had gained sufficient control over the atmospheric conditions in their kilns. This was a result of a long handling of pottery firing techniques.

However, R. F. Tylecote has pointed out that although

melting of metal can be easily done in a pottery Kiln, the latter would note be a suitable furnace for smelting. In order to obtain the reduction conditions necessary to divorce a metal from the oxygen it is the necessary to have close and intimate contact between the ore and the reductant. charcoal. This can be achieved in a pottery-kiln only with some difficulty. Tylecots suggests that it is much simpler to design a furnace for the job. This need be only a clay bowl or a hole in the ground into which, once it is not enough, the right proportions of ore and charcoal are introduced. The temperature in such a furnace would have to be maintained with the aid of a blast from a pair of bellows.[7] He also cites an example of such a furnace for copper smelting from the chalcolithic period (4th. millennium) at Timna.[8]

It may have been that such small-scale blast furnaces were devised by the ancient metallurgists after they had fully realised and mastered the know-how of the processes. But in the earliest days the Potter-Kilns may have played a role. how-so-ever difficult it may have been to smelt ores in them for the early artisans were still experimenting and did not know the full conditional requirements for smelting. Only after a lot of recurring failures and successes did they tumble upon necessity and advantages of a closed blast furnace.

I

ORES, MINERALS AND THE PROCESSES OF METALLURGY

Now we small go into a discussion of the actual processes involved in the production of metal objects. Here we must note the metals that have been utilised in our context. Copper was the earliest and most abundantly used metal. Tin, arsenic and lead were also used by the protohistoric people in the Indian subcontinent in alloying. We also encounter objects of gold and silver even from the pre-Harappan cultural period onwards. Iron occours in the Indian subcontinent around the first millenium B.C.

COPPER ORES :

Copper is very widely distributed in soil, water and ores. Native copper occurs on the surface layers. To obtain the various copper ores, viz., malachite, azurite. chalcopyrite, chalcocite, etc., mining in the rocks must have been taken recourse to by the ancient people. In the near East a number of regions harbour copper mines. A copper belt runs through northern Persia into the Caspian sea and beyond the Transcaucasia. The eastern extension of this belt runs into the Paraponisus, Kafiristan and the ancient copper mines of Bamian near Kabul.[9] According to wertime two ancient copper mines in the near East and W. Asia area Ergani Meaden in Central Anatolia and Anarak — Nachlak near Sialk.[10] In the early third millennium B.C. there was brisk trade between Dilmun (island on Persian Gulf) and Ur, a port of sumer. Copper was supplied in ingots and in the form of manufactured goods also.[11] Forbes mentioned that Edon near Khirbet-en-Nehas and Umen el 'Amad were the copper source for Palestine and Syria, dating back as far as C. 1800 B.C[12]

Nearer to home, Baluchistan and Afghanistan harbour copper ores in many regions. In Baluchistan old slag heaps have been found near Shah Ballaul and Robat.[13] In Afghanistan, the districts of Kashan, Konrud and Isfahan contain many important mines. Some of these were worked since very ancient time for Hiuen-Tsang mentioned several copper mines in Afghanistan.[14]

Sana Ullah suggested the following probable sources for Indus Valley copper, viz.,

Baluchistan : Shah Ballaul, Robart, Rāskūh, Kojak Amrān.

Afghanistan : Shāh Maksūd, Kaleh Zeri.

Persia : Anārak.

India : Ajmer, Sirohi, Mewār and jaipur.[15]

Edwin Pascoe regarded Jaipur in Rajasthan, Shāh

Maksūd and other areas in Afghanistan, Robât in extreme west of Baluchistan and possibly Nellore district of Madras as the probable sources of copper for Mohenjo-daro.[16]

In India the present mining areas are mainly located in Rajasthan, Bihar, Andhra and Kumaon. Besides, there are several other minor deposits. In Bihar the Singhbhum Copper belt runs over an extensive region. In Andhra Pradesh the Guntur, south Arcot and Hassan districts have copper ore deposits. In Rajasthan almost all the districts have copper ore deposits, the most important being the Khetri-singhana belt in the Jaipur District. Others are the Kho-Dariba mines in the Alwar District, Delwara Kirouli and Debari in the Udaipur District. As D. P. Agrawal mentions the Rajasthan copper mines have great importance as protohistoric sources.[17] We shall go into this matter later when we deal with the copper industry of the cultural contexts seperately. Here we would like to mention, however, that D. P. Agrawal mentions, on the basis of the findings of M. S. Srinivasan, personally communicated to the author, that the history of the khetri belt workings may be traced up to the Mauryan times.[18] He also points out that Abul Fazl, the courtier of Akbar (A.D. 1590) mentions these mines.[19] Rajaguru and Mujumdar reported many copper ore deposit working sites from Rajasthan. They reported that some of the openings like those at Kotri and Delwara appear to be very crude and small in dimensions.[20] We may refer here to some old workings revealed at mines in the regions mentioned above. In the Baluchistan the Sandak mines yielded slag specimens which are dated around 3500 — 3000 B.C.[21] In Afghanistan old workings have been noted near Kabul where vast quantities of slag and small rectangular mining entrances have been located.[22] In the Kashmir major clusters of old workings have been found in the Banihal, Anantnag and Baramulla districts.[23] The Garsah Valley near Chisnai in the Himachal Pradesh also have signs of old workings and slag heaps.[24] The old copper mines in the Kumaon lay in the

mountains between the Sutlej and the Kali rivers.[25] Sites have been located near Pithoragarh, in the area to the south of Badrinath and beyond Pokri.[26] In Gujarat old copper workings have been noted at Jhari in the Panchmahals.[27] In the Andhra Pradesh the Kurnool district provides evidences for old workings in the form of fragments of trap and Vien quartz.[28] The old workings of Guntur have been known to observers since the early nineteenth century.[29] In the karnataka there are several disticts where old workings near mines have been identified as in the Bellary, Mysore, Shimoga and Hassan disticts.[30] Like Rajasthan and Karnataka, Bihar is also full of evidences. The Singbhum belt is extensive and several areas reveal old workings. In Hazaribagh district also evidences come from the Baragunda region.[31] In West Bengal old workings are evident. In Bankura the Tamkhun and Chhedapathar mines bear signs of old workings which go back to 5th — 6th centuries A.D., if not earlier[32]. The Buxa region has a pri-industrial mining tradition.[33]

The nature of such old workings is crude comprising superficial gouging, vertical shafts and, very rarely, deep shafts connected with underground gallery. The workings are irregular, galleries inclined inwards, drainage of the mine is ignored. The veins were fossicked out with little regard to safety. The entrances are narrow. The way of baling out water was to arrange a chain of human beings passing full pitchers to the mouth of the mine.[34] It is clear, however, that deep shaft mining was an improbability in the pre-iron days.

ARSENIC :

It is now generally accepted that a distinct phase of metallurgical development occured at the begining of the Bronze Age with the introduction of arsenical materials into the charge to produce copper-arsenic alloys. Copper-arsenic alloys have many advantages over pure copper both in terms of fabrication by casting and working and in the resultant mechanical properties. The arsenic contents indicate that there was either deliberate use of high arsenic-content copper

minerals or the addition of arsenic-rich materials to an otherwise normal copper smelt or melt.[35] In the Indus copper artifacts a high proportion of arsenic has been noted. Arsenic minerals have been reported from West Bengal, Rajasthan, Kashmir and Bihar.[36]

TIN :

The copper-tin alloy, bronze has also been used by the Harappans. J. A. Charles points out that the development of tin bronze may have been possible in two ways : (a) The introduction of tin to the copper could have followed a successful use of a material i.e. stannite, that looked like arsenic copper ores that the copper smiths were already using before. (b) The use of gossan from deposits in fluxing for smelting copper which produce some low-level of tin that might have got associated with the copper that was being smelt.[37] Some of the tin used by the Harappans in alloying must have come from outside the Indian sub-continent for there are no major tin deposits in this region and there are no indications of old mining. However Tin ore deposits in Hazaribagh, Ranchi, Gaya in Bihar, Banas Kantha in Gujarat, Dharwar in Mysore and Bhilwara in Rajasthan do exist. Besides, old workings of mineralising tin are prevalent in the Bastar region in Madhya Paradesh[38] and in the Ranchi and Hazaribagh districts in Bihar.[39] There sources may also have been used.

The main tin fields of antiquity are in Asia Minor, the region of Caucasia and Transcaucasia, Persia, the tin belt extending from Burma, Malaya to Billiton, and the deposit near Lake Baikal.[40] D. P. Agrawal suggests that the ancient smiths may have used the stream tin or the cassiterite that is washed down from the stanniferous veins in granite rocks in the river streams along with alluvial gravels. The washing action of the stream concentrate this mineral that may have been obtained by the ancient people.[41] Sanahullah mentions that although the Hazaribagh mines appear to have been worked in ancient times, yet a supply of Hazaribagh tin ore

to the Indus Valley must be discounted for bronze is scarce in the Gangetic Valley itself indicating that this mine could not have met the demands of the local people or that the mine was not worked as early as the third millenium B. C. Moreover, he mentions that Hazaribagh was isolated from Northern India by deep forests even in the early historic times. He suggests that the sources of tin for the Harapans lay in the Norht-West. In the circumstances the kārā Dāgh District and Khorasan in North-Western Persia may be taken to have been the probable sources of the mineral for the Harappans.[42] Sanahullah later pointed out that the most likely sources for tin to the Harappans were the alluvial deposits of cassiterite. He also points out that these thin deposits might have been used up without leaving any evidence of the operations behind.[43]

LEAD :

This metal has been used by the Harappans quite extensively. Lead has been added to copper to increase the fusibility of copper by the Harappans as well as other chalcolithic folks.[44] Silver has also been extracted from lead.

Lead is known to occur at many places in Rajasthan, Bihar, Orissa, Madhya Pradesh and Tamil Nadu.[45] The Zawar mines in Rajasthan were exploited since the fourteenth century A. D.[46] However, the lead exploration activities discerned at the Rampura — Agucha belt in Rajasthan dates back to the ninth century B. C. and can provide data for correlation. There are heaps of ancient debris deposited as surface manifestation at this mine. The ancient workings are visible on the surface in the form of old trenches and pits, underground drifts, raises, inclines and stopes cut out in exploratory operations. Even extensive underground operations have been located. The drill holes used to intersect the old underground works reveal the intensity of mining activites. The deepest old working goes 80m. below the surface.[47] If the parametres are based on this example then one has to consider the beginnings of trenching prior to the

first millennium B. C. However, more such explorations and analyses of mining data are required for drawing conclusions.

Outside India proper lead-ores occur in many localities in Southern Afghanistan and Persia. At Faranjal in the Ghorband Valley of Afghanistan an ancient lead mine with very extensive working has been reported. The richest mines in Persia occur around Ispahān, Kirmān, Teheran and in the Elburz mountains.[48] Pascoe suggests that the Mohenjo-Daro lead may well have come from Ajmer, or from the Fāranjal mine in Afghanistan and other mines from southern Afghanistan or from Persia.[49]

GOLD :

Gold and less frequently silver were other metals used by the protohistoric smith in our sub-continent. This metal has been used to quite some extent by the Harappans for making personal jewellery. It also occurs rarely at other chalcolithic and Iron-Age sites also.

Gold occurs in two chief forms, in alluvial deposits and in reefs and veins. T. A. Rickard puts forward that in the ancient times everywhere the working of the alluvial or placer gold preceded vein mining.[50] However, the evidence of the antiquity of alluvial gold working is rare and indirect for such working require little permanent equipment and leaves little or no trace.[51]

In Afghanistan, gold occurs north of Kandahar, in small quantities in the north side of the Hindukush. Other sources are the streams draining the Kūh-i-Bāba, streams in Kohistan, and above Laghmān and Kunar.[52]

In Persia, Dāmaghān, south of Asterabad, the region near Meshed, the region west of Zenājān, Tihrān Hills west of Ispahān, Elwend hills near Hamadan, near Geligah in Māzandarān, near Shāh Abdul Azim southeast of Teheran, north-west of the ruins of Takht-i-Suviman west of Zenjān, and Kūh-i-Tukh Rāja are the known gold localities.[53]

The modern supplies of gold in western Tibet are entirely alluvial, Siberia is also rich in gold. Gold is washed in many

places in the Karakoram and many rivers in Central Asia.[54] Pascoe points out the although the Harappans at Mohenjo-daro could have drawn supplies from the above source, the chances seem more in favour of the South Indian sources of gold which, he points out, seems to have been most accessible, inspite of the nearness of the resources in Afghanistan, Western Tibet and parts of Persia.[55]

F. R. Allchin points out that alluvial gold washing is carried on in many parts of the sub-content.[56] The two most important areas of alluvial deposits are in Chota Nagpur and in the Valleys of certain Himalayan rivers. It is doubtful whether the Harappans used the alluvial deposits in Bihar. In the valleys of the upper Indus, Chitral (now in Pakistan) and elsewhere in the former North West Frontier Province of Pakistan and also in parts of Kashmir and Ladakh, small scale production of alluvial gold has gone through centuries.[57]

However, as Pascoe points out, the auriferous bands of the South Indian Dharwar rocks may have been used as sources for the gold of Harappan, as well as other Neolithic-chalcolithic cultures.[58] H. C. Bhardwaj also points out that the gold from the Kolar and objects recovered from the Harappan sites are of the light colour, being electrum, the native gold-silver alloy. Hence, he suggests, that it is justifiable to infer that the Harappans used the gold of the Dharawar Veins. He also points out that the clustering of Neolithic sites around the South India gold mining areas and recovery of gold ornaments from the limited excavations of Neolithic-Chalcolithic site of Tekkalkota and Chalcolithic site of Daimabad in Karnataka and Maharastra, respectively, confirm that the gold mines in South India were being exploited during and after the Harappan period.[59]

F. R. Allchin points out there is evidence of very extensive old activity, both of the open-cast and deep mining at several places in South India.[60] As Bhardwaj points out, at the beginning, gold nuggets were collected from the surface and gold was mined by 'open cast' method. Later deep-shaft

mining by fire-setting etc. may have been taken up. The small pure metallic nuggets collected from the surface of the mining area or by open-cast mining could have been hammered and directly shaped into simple ornaments and should not have required much expertise of gold-smiths.[61]

F. R. Allchin states that the Mineral Map of Mysore State (1916) shows some fifty gold working locations [62] which, the Bulletin of the Department of Mines and Geology, Mysore (1916) informs, are in almost all cases the sites of old working.[63] Allchin mentions some of the old workings in different regions, in the Karnataka state. Bruce Foote had also mentioned some old workings in the course of his survey of the rocks of the Dharwar system,[64] of which the noteworthy are the workings at Sonnahalli, 18 miles south-west of Mysore.[65] Others mentioned by Allchin are at Bellibetta, 20 miles north-west of Seringapatam ; at Kempinkote, some 45 miles north-west of Mysore, a vast number of old workings north-west of Halebid, old workings at Woolagiri, some 20 miles south-west of Mysore ; a small cluster of gold working in the Nilgiri hills and Wynaad, an interesting and important group of old-gold working on the Gadagband, lying between the town of Gadag and the river Tungabhadra, and lastly, the most remarkable and interesting group of old workings and mines in the Raichur District, lying between Hutti and Maski.[66]

Allchin has described the archeological evidence from the Hutti field.[67] We need not go into the details of these. But these evidences coupled with radio-carbon dates that fall around C 1890 ± 70 B. P. and 1810 ± 70 B. P [68] indicate that the atleast the Hutti mines were being worked, even at depths of 250 ft. during the first centuries of the christian era. [69] Allchin also points out[70] that Kautilya in his Arthasāstra (C 300 B. C.) informs us that the Dakṣināpatha, the route which ran southwords from the Ganges Valley, was to be prefered to the Uttarapatha because the former produced conch-shells, *Vajra* or diamonds, gemstones, pearls

and gold. Kautilya further states that the Dakṣināpatha had many mines *(bahukhani)*.[71] Moreover a number of Aśokan inscriptions have been found at five sites in this area. The Minor Rock Edict at Maski is actually located on the gold field. Two edicts are about 30 miles from the Gadagband gold mines. The three edicts at Brahamagiri are near several mines in north Mysore and Sandur.[72] Allchin suggests that the Aśokan edicts in South India reflect a very material interest in the area.[73]

If this argument is accepted it will be seen that the beginning of large scale minimg of the gold veins may be expected to coincide with the period of Mauryan Colonisation of the Deccan towards the end of the fourth century B. C.[74] Allchin quite plausibly argues further that for such operations to have started at that time the report of gold deposits in an area so remote had to reach the centre of the Mauryan Kingdom, so that Mauryans would take an interest. Thus some sort of mining by the local people must already have been going on in these regions of South India.[75]

Allchin points out further evidence in favour of this theory. He suggests that the way in which the Neolithic settlements seem to cluster around the Maski, fields : Maski, Piklihal, Anandgal, Kodekal, Watgal and several smaller settlements, almost all within five miles of the auriferous zones, indicate an association between these settlements and the mines.[76] He finds a second hint in the abundance of large broken crushing and rubbing stones found among the debris of the Wandalli and Gaudur ash mounds.[77] Allchin mentions that although the excavations at these sites proved that in all determinable cases these ashmounds were sites of neolithic cattle-pens,[78] yet the presence of this stones at Wandalli and Gaudur may indicate that small scale and local extraction of gold was already taking place during the Neolithic Period. These two sites are situated on the edge of the Wandalli and Hutti Zone.[79]

Thus Allchin postulates that the first discovery of the

gold bearing reefs was made during the Neolithic period (end of third millennium to the first half of second millennium B. C.). However, as Allchin points out, the work at this time would have been mainly on the surface,[80] as we have already mentioned. This work would have consisted of the search for exposures of suitable rock, its smashing by fire-setting, crushing etc. for the tools available were too limited for deep mining. Stone picks found in local neolithic assemblages and the copper chisel from Piklihal are typical of the tools that would have been employed.[81] But, Allchin suggests that probably the work at this time was sufficient to encourage the growth of settlements around the gold fields. A new stage would open with the arrival of iron, which may have coincided with the spreading of fame of this rich region to distant Magadha.[82] In view of the above evidence it seems highly probable that the auriferous deposits of south India supplied the mineral gold to the Harappans and the neolithic and chalcolithic folks in the Deccan, as Pascoe and Bhardwaj suggest and as Allchin indirectly hints.

SILVER :

The ancient lead mine at Fāranjal in the Ghorband Valley. Afghanistan, yields a small quantity of silver. Silver may also have been derived from many other lead localities of southern Afghanistan, Persia and Armenia.[83] In Burma. Bawdwin mines of argentiferous galena are of special economic importance. It supplied large quantities of silver since many centuries back. From the slag heaps around these mines it seems that only silver was extracted and lead was left out.[84]

Silver is not reported to occur in India as a primary mineral. Sources of silver may be attributed to either of the following secondary sources :

(i) Silver associated with gold from Kolar gold mines in Mysor ;

(ii) Silver associated with galena (argentiferous).

Silver associated with gold is produced in considerable quantity today at Kolar in Mysore and to a much smaller extent in Anantpur in Madras.[85]

Silver is obtained from lead ores from various localities in India. In the Bhagalpur, Manbhum, Monghyr and Singhbhum district of Bihar and Orissa, silver has been found associated with lead, but neither metal in considerable quantity. Similar occurances have been met within the Rawah State and in the Drug. Hoshangabad and Jabbalpur District of Madhya Pradesh. The Kulu Valley in the Himachal Pradesh is rich in argentiferous galena.[86] Ancient mines of Zawar, 15 miles south of Udaipur in the Aravalli region of Rajasthan, are reputed to have been worked in ancient period to obtain silver from the zinc blend argentiferous galena.[87]

Pascoe is of opinion that if the ancients knew how to seperate silver from gold, it is possible that the Mohenjo-daro supplies may have come with the gold from South India.[88] However, the archaeological evidence show that the use of silver was restricted to the Harappans in the Indus Valley only. There is no evidence of silver objects from subsequent cultural contexts upto the NBP Ware Culture, except Hoard assemblages at Gungeria. Hence, it may be assumed that the gold from South India was not used by the Harappans to extract silver. Otherwise there would have been evidence for the occurance of silver at least in the Deccan and South India. It is more probable that the Harappans in the Indus Valley might have used the Silver from the mines in Afghanistan, Persia, Armenia and even North Burma. Edwin Pascoe also suggests the above sources as probably used by the Harappans.[89] But, it is equally likely that the Harappans extracted silver from argentiferous galena or lead that was available.

IRON :

Iron ore deposits abound in various parts of India. The country has richest deposits in this mineral both in quantity and quality. The principal minerals of iron comprise

magnetite, hematite, turgite, geothite, limonite, siderite, pyrite, pyrrholite, ilmenite, greenalite and chemosite.[90]

The richest deposits of iron ores in India occur in Bihar, Madhya Pradesh, Orissa, Maharashtra, Mysore and Madras. There are some ores also in Kashmir, Patiala (Punjab), Mandi (Himachal Pradesh), Kumaon hills (Uttar Pradesh) and Assam. There are quite a few mines in Rajasthan as well. which have been worked at various times, and the ores were smelted in the indigenous furnaces as at Rajgadh in Alwar District.[91] In south India magnetite ore occurs in southern districts of Karnataka. Haematite occurs in Shimoga, Chikmagalur, Dharwar and Sanur in Karnataka and Ratnagiri in Maharashtra. Magnetite-quartzes occur in the Salem and Tiruchirapalli in Tamil Nadu and Guntur in Andhra Pradesh.[92] Haematite and ferruginous quartzes occur in Cuddapah Andhra Pradesh.[93]

The distribution of Iron ores in India has indeed a bearing on the mining and smelting operations at different times. even in the protohistoric times. It also indicates the possible geographical extent of the areas where the iron industry could have developed at an early date.[94] It would have been natural and easy to develop iron industries near iron-ore deposits in the early days of the Iron Age in India. Hence the location of ore deposits necessarily had a bearing on the growth of industry in any region. In this context. H. C. Bharadwaj points out that it is not without significance that two nuclear cultural zones of iron Age namely Magadh, and Deccan and the south were comfortably located near the rich iron-bearing areas.[95] Pre-industrial smelting of iron has been reported by Ball from Waziristan. Kanigaram is an area which is locally reputed as having been an iron-smelting centre evident from the furnaces, slag and heaps of ore in the neighbouring villages.[96] Arround Kanagra and Kulu in Himachal Pradesh, pre-industrial iron-smelting have been discovered including preparation of saucepans and large boilers.[97] In the Rajasthan ancient working have been reported from Bharatpur, Bundi, Jodhpur and Kota.[98]

However, most of them have unfortunately not been explored and analysed fully. Only the old mines of Bhangarh and Rajgarh in Alwar have been located to have open-cast operations several hundred yards long and 20-30 yards wide, connected with short irregular adits. Pre-industrial furnaces were in operation in the Kutch, Gujarat. Gwalior in Madhya Pradesh possess rich iron deposits. At some of these mines extensive evidence of pre-industrial mining is available.[99] In Karnataka, early iron workings have been located in the Chitaldurg hills and in Kandur east of Baba Budan and around Urbani.[100] Pre-industrial smelting was distributed widely over the Cuddapah district in Tamilnadu.[101] The deposits in south Singbhum and Keonjhar as well as Mayurbhanj are extremely important iron - belts and to the early smelters of iron in Bihar and Orissa the lateritic outcrops must have been a rich source.[102]

Thus it becomes clear that iron deposits which were widely distributed throughout the subcontinent provided an easy access once the smelting techniques were mastered by smiths. The traces of old workings at most of the regions lend force to the hypothesis. Although the thesis of Vedic Aryans having introduced iron in the subcontinent still runs high, yet the above evidences do support a theory of multi-centre development of iron smelting technology.

THE PROCESSES :

The earliest copper-smiths perhaps began with the simple use of native copper.[103] As Wertime has described, at this stage perhaps the smiths applied the processes of hammering the cold copper,[104] the earliest technique. Cutting, bending, grinding and polishing of the copper objects were all done in this earliest stage.[105] From here early copper-smiths are led on to the process of annealing[106] which requires the heating of the metal above its recrystallization temperature and then allowing it to cool down slowly. This is done in copper in a temperature above 500°C. The process of annealing relieves the strain within the metal. The atoms

become mobile and then return to stable position when metal is cool.[107] As C. C. Lamberg-Karlovsky points out, the malleability of native copper was already recognised by the smith in cold hammering. Gradually, the smith would have become cognizant of the fact that repeated cold hammering in a restricted area allows for greater malleability of that area due to superficial heating of the object from rapidly repeated blows of the hammer. This would have led the artisan to introduce the native metal or ore into a fire, thus gaining greater control in manupulating the material prior to the actual hammering, for the heated metal is much more malleable.[108]

The next step leads to the evolution of smelting and casting.[109] In hammering and particularly annealing the artisan already recognised the merits and increase in the malleability of metal due to heating. Melting native copper over furnace or fire is the natural extension in the application of heat to the ore. Smelting was another step from here.[110] The original native copper has less than 5% of pure copper.[111] Smelting of ore in wood or charcoal fire over a clay-lined pit with air would produce refined copper or regulus and slag.[112] The latter is thrown away and the regulus is used to shape various objects. We have already seen how special sort of Kilns would have facilitated the smelting of ores. In this case, pottery Kilns may have had a role in the early days, although they were quite unsuitable and soon the copper-smiths developed the crude blast-furnaces, described above, to smelt copper. Clay crucibles may have been used in these operations. Tylecote mentions[113] that the earliest known crucible furnace is perhaps that from Abu Matar, the Late chalcolithic site near Beersheba (C 3300- 3000 B. C.).[114] In India we have been not come up with full-scale blast furnaces in protohistory but clay crucibles have been recovered at many sites.

The next step, as C. Renfrew describes it is, that of casting copper in an open mould.[115] As C. C. Lamberg-

Karlovsky points out, casting is just one step from melting. After the metal is melted it is cast into stone, clay or sand moulds.[116] He also points out that stone moulds were already in use when only cold hammering was practised. The metal placed in the mould would be hammered to take shape and contour of the mould. But now, after melting, the matter became very easy.[117] The process of double mould casting and casting-in followed that of open-cast.[118]

As we have already noted above and as C. C. Lamberg Karlovsky emphasises, the development of the processes of smelting, melting and casting did not result from a successive series of independent discoveries and inventions, isolated from the development of other crafts. The development of metallurgy was additive, dependent upon the crafts of pottery making ; Kilns and furnaces for the recognisation of the effects of firing temperatures and reducing/oxidising atmospheres ; as well as stone-working for mould production.[119]

Only after the ancient copper smith had mastered the processes of smelting and casting did he tumble upon the idea and implementation of alloying. According to C. Renfrew casting techniques were followed by the introduction of alloying of copper with tin or arsenic.[120] Wertime designates, this stage as the 'origin of Bronze'.[121]

Lamberg-Karlovsky points out that as the development of all the other metallurgical techniques from the earliest days, the development of alloying is also best seen as a slow processual development, rather than a spontaneous invention, which took place around C 3200 B. C. in the world context.[122] He suggests that the use of ores from different deposits would have led the artisans to the recognition that molten metal from certain deposits could be more successfully cast and then fabricated.[123] The craftsman would not have been aware that he was dealing with ore deposits which contained natural impurities of arsenic, lead, tin etc. The fact is, however, that certain ore deposits would have become preferable. The recognition of the value of certain ores over others would

have become a stimulus to long distance trade for those ores.[124] He points out that there are many examples of copper objects which have significant amounts of natural impurities and which makes this hypothesis tenable.[125] Incidentally we may mention here that these impurities in the ores are used in the spectroscopic analysis to correlate copper artifacts of many sites to the ores of different mines which may have been the probable sources of the metal for those sites. Now, with the recognition that certain ores were better than others for casting, the craftsman began to experiment by combining certain ores and metals.[126]

Thus the accumulated experience of experimentations with ores having significant amounts of impurities, the recognition of these advantages, and the subsequent attempt at stimulating these ores without understanding the range of physio-chemical changes the metals underwent in the process, led to that step in metallurgy which as Wertime calls it, is polymetallism[127] which began with the process of alloying.

The lost-wax or *cire perdue* process of casting evolved now.[128] D. P. Agrawal points out that even before the use of tin-bronze, the copper smiths in the Late Uruk levels could cast *cire perdue.*[129] H. D. Sankalia describes the process by stages.[130]

(i) a model is first made on a clay core in wax. The thickness of the wax depends upon the thickness of the metal required.

(ii) next to the wax model a single outer mould of clay is built up. This is provided with various devices to allow the wax to be drained out when melted, such as sprue-cup (the passage through which metal is poured into mould), runner (grooves), risers (arch or incline), and vents.

(iii) then the entires thing is heated so that the wax melts and runs out. While this happens the inner core of clay might shift. To prevent this happening, chaplets (thin rods) are inserted which hold the core to the outer mould. These later become parts of the final cast objects.

(iv) The molten metal is then poured into the cavity thus prepared.

(v) The outer clay mould is broken. The inner core some times remained ; sometimes it is broken into pieces.

(vi) When the mould is broken, the object cast comes out, but this has a rough surface. This is later made smooth by polishing.

Thus, we find that the technology of metallurgy advanced step by step through a gradual process marked by continuous experimentations, failures, successes, chance discoveries in the process of these experimentations, all throughout aided by great energy, curiosity, devotion and endurance on the part of the early metal artisans.

II

THE EARLY AND PREHARAPPAN EVIDENCES

It is generally believed that Tal-i-Iblis near the copper rich Karman range in Iran was one of the earliest known centres of copper metallurgy (C 5000-4000 B.C.).[131] Here crucibles were recovered which were used for smelting ores.[132] The earliest occurrence of metal in the Indian sub-continent is reported from the Aq-Kupruk cave of Ghar-i-Mar in north eastern Afghanistan. Here we come across metal artifacts from the chalcolithic levels for which two radio-carbon dates are available, viz. C 5487 and 5291 B.C.[133] L. Dupree has separated this level from the Ceramic Neolithic at Ghar-i-Mar on the basis of stratigraphy, pottery and the presence of metal.[134]

The metal artifacts located at Ghar-i-Mar consisted of three fragments of sheet metal with an embossed motif, two fragments of a rectangular rod, and one other sheet fragment.[135] Caley, who has analysed the metal artifacts, maintained that the composition of the metal was soft enough for the embossed design to be produced by hammering on a soft substance (wood) when the metal was heated. The reconstructed original composition of these artifacts indicate a very high percentage of copper with about 7% tin and traces of iron and nickel, a composition which according to Caley, is characteristic of the early stages of bronze metallurgy.[136]

Shaffer points out that the great importance of this site lies in the late sixth millennium B.C. date for bronze technology, one of the earliest dates for such technology recorded in world.[137] Moreover, we have already noted the fact that the earliest evidence of domestication of cattle (Bos Primigenus) and onager comes from this and other caves at Aq Kupruq. If these datings and evidences are accepted then the advent of the copper-bronze metallurgy in this sub-continent will indeed rank among the earliest of such evidences in the world. It would also appear that the north-eastern Afghanisthan was a cradle of much cultural advancement.

The evidence from Mehrgarh would further substantiate the fact that indeed metallurgy had appeared quite early in this sub-continent. This site in the Kachi Plains, Baluchistan, on the borders of the Indus Valley, has yielded a ring and bead in copper in the Period II levels (sixth and fifth millenia B.C.). A small copper ingot comes from an early level of Period IIB which witnesses the appearance of ceramics on a large scale. As J. F. Jarriage, the excavator, nevertheless, points out, metallurgy here was still apparently a limited activity, judging from the small number of finds.[138] If these copper objects were made locally then the artisans must have only started to develop the technology of metal working and were still at a stage where the hammering and polishing of native copper was the only technique they had known and employed.

However, we may recall that already the people at Mehrgarh were engaged in a farming economy, had domesticated sheep, goat, cattle and in the Period IIA sequence, a few coarse chaff tempered wares, often slipped in plum red, appear.[139] The period IIB saw the introduction of Plain red ceramics at Mehrgarh[140] and as we have noted above, the small copper ingot comes from this level. We must also recall that Mehrgarh boasts of well-planned compartmented brick buildings that may have been used as storage units for several crafts as well as grains. This indicates

the great social organisation working at the time at Mehrgarh.

The period III level at the site yielded a few crucibles containing traces of copper which reflect an advancement in the technology of metallurgy.[141] Smelting may have begun locally at the site. Jarrige suggests that this could also explain the changes in the lithic and bone industry. The bone awls, he points out, were becoming rare.[142] This period may be dated to the second half of the fifth millennium.[143]

Interestingly, explorations and soundings by Beatrice de Cardi and W. A. Fairservis have shown that the area of distribution of pottery typical of Mehrgarh Period III (Togau A., Kile Ghul Mohammad III, Loralai striped or Jangal painted styles) extends over the whole highland valley system, Zhob, Loralai, Quetta, Kalat and Surab, all surrounding the Kachi Plain.[144] Some sites in these regions would yield copper artifacts in the subsequent times as we shall see. Moreover, Mundigak in South-east Afghasnistan, where the cultural assemblage of the first settlers show almost a total identity with Mehrgarh Period III, as far as pottery is concerned,[145] would also yield copper artifacts in the early days (period I_2).[146]

At Mundigak the Period I_2 first saw the appearance of metal artifacts. The earliest objects was a flat blade-like instrument which might have had a hafting tang. A simple type of bronze point or punch becomes the, most frequent metal artifact in the entires Mundigak sequence and it is so easily available that it replaces the bone awl/punch in Period IV at the site.[147]

We may note that the phases 1 to 2 of Period I of Mundigak are devoid of any substantial architectural remains. The first substantial or permanent structure was encountered in Phase 3 which consisted of two pise walls.[148] Thus, it seems that the earliest semi-nomadic folks had been introduced to the metal and then onwards copper and copper metallurgy became a part of socio-economic life at Mundigak. The MASCA corrected radio-carbon date for Period I_2 - 3 is C 3745 B. C.[149] Thus the first half of the fourth millennium

B. C. witnessed the first appearance of copper in south-east Afghanistan.

The Period II_3 noted further development in the shape of the bronze punch already extant. In this period we find that the first example of a true projection point, lancelot in shape with an elliptical cross-section appears. Since then this type of point became increasingly frequent.[150] Period II_1 or I_5 is dated around C 3635 B. C.[151]

In period III a tanged Lozenge shaped point was introduced and in period IV a tanged oval shaped point. Other possible weapons found in period IV were a large lance-head and knife (sword). But these artifacts are very rare.[152] Mundigak III would date around the middle of the fourth millenium B.C. to the beginning of the third.[153] Mud-brick structures appeared from period I_4 - 5 onwards. Period III witnessed an increased density in the number of structures per excavated area.[154] Large rectangular multi-chambered mud-brick ovens, oval or U-shaped, come on the scene from phases 4-5 of Period I.[155] They may possibly have been domed also.[156] Shaffer reports that analysis of these ovens indicates that extremely high temperatures (600-1100) were produced in them.[157] Their location in a large open space, exterior but adjacent to habitations might indicate the beginning of functionally specific areas within the site.[158] It may have been that these ovens, besides being used for firing ceremics also served some of the purpose of copper metallurgy.

The first examples of "Luxury" items in metal were located in period II_3. These constitute of two pins, one with a double volute end, while the other had a flattened and perforated end. Similar pins with flat ends and twisted shafts were also found in Period III (C 3500-2800 B. C.). Frequently encountered are some utilitarian objects throughout periods III-IV. These were small curved knives or sickles and chisels, two socket-hole axes from Period III_6 and an adze from the same period.[159]

Shaffer reports that elemental studies of some of these artifacts indicated some interesting aspects of the metallurgical sophistication represented by these objects. Analysis of one artifact from period I_5 demonstrated that it was very low-tin bronze. Tin accounted for only about 1% iron 0.15% and the remaining material was copper.[160] Such a composition was a striking contrast to the high-tin content of the chronologically earlier material located at Ghar-i-Mar. Of the artifacts subjected to analysis from period III only the axes and the adze had a composition approaching that usually associated with bronze. These artifacts had a tin content of almost 5%, the highest recorded at Mundigak.[161] As Shaffer also points out,[162] implements like axes and adzes ot be efficaceous had to rely on weight, force and hardness. A high tin content in the copper would assure these qualities. Whereas, points, pins or knives having different small-scale usages would require different characteristics. In a situation where tin might have been rare, and was being handled for alloying purposes for the first times, it would be utilised with care and wisdom. Hence its addition to copper for making axes, adzes would deem proper than its use in making other smaller items. It appears therefore that by the Period III the smiths at Mundigak had recognised the differential characteristics of various alloying compositions and metallurgy was entering into a new phase of sophistication and presumably specialisation.

At Deh Morasi Ghundai, near Mundigak in south-eastern Afghanistan, small metal artifacts occur throughout periods IIa to IV.[163] A single radio-carbon date is available for period IIb, viz., C 3200 B. C.[164] Thus, metal appears at this site prior to this date, about the middle of the fourth millennium B. C. The metal artifacts of period IIa comprise two fragments of a hollow tube and a fragment of handle in copper.[165] Several fragments of simple pins were located in Periods IIb-c and a single fragment of compartmented seal from Period IV.[166]

At Said Qala Tepe however bronze artifacts are confined to the latest prehistoric occupations (end of period II-IV). However, the metal assemblage here is of a more functional nature than that at Deh Morasi Ghundai. For example, here we come across sickles, blade fragments, a lancelot or lozenge tanged point and a point or punch with circular cross-section. Luxury items consisted of pins with double volute heads, flattened with forked end, and simple forked end with twisted haft. A single example of a bronze handle fragment with a rounded and perforated distal end was found. Shaffer points out that, in general, the artifacts were very similar to those found in Mundigak III.[167] The radio-carbon dates here are Period I = 2110 B.C., Period II = 2160 B.C., and Period III = 2230 B.C.[168] Although the dates are somewhat confusing yet they all come from the end of the third millennium B. C., hence this site may be taken to have flourished at that time. The similarity in the metal assemblage with that of Mudigak may indicate that the metallurgical traditions of the bigger site was being handed down to smaller, corresponding sites in the adjacent areas.

After the experience of Mehrgarh in Baluchistan, we note that copper and perhaps copper metallurgy was slowly and gradually percolating into other regions in Baluchistan. As we have already noted, the pottery of Mehragarh III had affinities with that of Kili Ghul Mohammad III in the Quetta region. The first copper was also found in this period along with the distinctive KGM Pottery decorated with black or red painted designs.[169] We may also point out that the typical Harappan motifs like the bull and pipal leaf as well as bricks begin to appear on the scene at this site from this time onwards, in spite of the continued presence of the earlier Iranian influence noted in the Halaf style decorated motifs used on Pottery.[170]

At Damb Sadaat, 13 Km. west of the town of Quetta, we find the Kili Ghul Mohammad tradition and sequence taken up around C 3180 and 3150 B. C.[171] Here the presence

of metals is noted in Period II levels attested by the occurrence of a copper dagger or knife and some copper fragments.[172] The settlers were living in mud-brick houses containing hearths and bread ovens.[173] A new ware, popularly known as the Quetta ware makes its appearence in this period. The radio-carbon dates are available for period II, viz., C 3150, 2920 and 2630 B. C. The Period III at Damb Sadaat witnessed greater advancements in the life-style of the inhabitants. The Allchins state that an ambitious structure with brick walls of monumental proportions was constructed in this period.[174] It also consisted of a square platform with drains and foundations deposits some leads ore also occured in Damb Sadaat Periods II - III.[175] This last is quite interesting. However, it cannot be ascertained whether the ore was used in alloying with copper or not.

Periano Ghundai in the Zhob Valley, extreme north of Baluchistan, yielded a copper rod and a ring.[176] The middle and upper strata at this site, where the copper objects occured, have affinities with the pre-Harappan cultures of the Indus region, and the loralai and Quetta Valley sites, respectively. Thus we may assume that copper metallurgy may have been introduced into the extreme northern Valley of Baluchistan from the Kachi plains and adjacent regions as well as Kili Ghul Mohammad in the Quetta region.

Coming to the south Baluchistan in the Kolwa, region where a number of Kulli sites are encountered we find that the copper metallurgy has already appeared between the second half of the fourth and first half of the third millennia.[177] The type site of Kulli yielded some fragments of copper.[178] The cemetery at Mehi, located between Nal and Kulli in the Mashkai valley between the foot of the precipitation cliffs of the Mehi hills, yielded quite a significant amount of metal artifacts, viz., copper hair pins, bangles, discs and bowls.[179] An outstanding find is a copper mirror with the handle representing a stylised female figure.[180]

The Nal cultural settlements spread over the valleys of

the river Hingol. Interesting evidence as to metal and metallurgy has come from the type site of Nal, Sohr Damb, situated in the vicinity of the village Nal in central Jhalawan.[181] In the necropolis at Nal several copper and silver implements have been recovered, comprising long narrow flat axes of copper and ceremonial spear-heads of silver.[182] This is perhaps the first occurrence of silver in the Indian subcontinent so far recorded. In the Area F of the site a copper seal and a copper chisel, fragments of copper chisel, beads, seals and silver finger ring etc. have been recovered.[183] D. P. Agrawal mentions the occurrence of adzes, daggers, saws and awls also.[184] He also states that a small amount of lead ore and slag found at the site show that lead was extracted locally.[185] An adze fragment from Nal, when analysed, shows 2.14% lead and 4.9% nickel. Moreover lollingite, the iron-arsenic ore is also reported from the site.[186] The above evidence may indicate that the metal smiths in this region were perhaps experimenting with different metals and the technique of alloying was being gradually understood and employed. The presence of lead ore and slag may not only indicate that the ore was being used for alloying with copper only but also that silver was being extracted from the lead ore. If that had been the case then it seems that the metal smiths at Nal had really advanced a lot in the field of metallurgy. The architectural features of the site, the wheel-turned fine pottery assemblage, painted with animal and plant motifs, the terracotta animal figurines, beads of semi-precious stones etc. indicate a flourishing cultural development.

Further south-east in the Las Bela plains, the site of Balakot witnessed the appearance of metal in the Pre-Harappan Balakotian level. Many bits and pieces of heavily oxidised copper samples were available for study. Among them were two large copper scoria (pieces of slag), two corroded copper prills (beads probably) and two shaped copper pieces.[187] G. F. Dales reports that examinations carried on by Robert Maddin, Vincent Piggott and

Mohammad Aslam Ursani show that one of the shaped pieces, about 2 mm thick and 2 cm long, was apparently formed by cold working .[188] or work hardening which is a stage of metallurgy preceding that of annealing.[189] The second shaped objects is a copper bracelet fragments formed by rolling a small sheet of copper into a tube. The tentative conclusion, based on this very meager sample, is that the Balakotians were poorer in metal in comparison to the Harappan setters who came to the site later.[190] The processes of metallurgy employed by the Balakotians, as the above evidences suggests, were still very basic consisting of hammering and cold work. It appears that while many sites, contemporary or slightly later, in the Baluchistan were advancing rapidly in the field of metallurgy, some pockets existed where the techniques had not yet reached the same levels.

Further north-east in the Indus Valley, an early settlement at the site of Amri (Period IA) has yielded copper scraps,[191] which is dated prior to C 3900, for the MASCA corrected dates for Amri IB-C come between C 3900-3700 B. C.[192]

We would now like to note the first appearance of metal in the regions to the north and east of Baluchistan. Jalilpur in the south-western Punjab, about five kilometers south of the left bank of the river Ravi, witnessed the appearance of metal in Period II which consisted of copper or bronze rods,[193] copper bangles, rings, and pins.[194]

The site of Sarai Khola, lying in the Gandhara region, about 2.5 Km. south-west of the Bhir (Taxila) mound, has yielded a variety of copper objects in the Period II sequence, viz., copper antimony rods, pins, bangles, needles, nail papers and spear heads.[195]

In the Rajasthan the beginning of the third millennium B. C. saw the pre-Harappan settlement at Kalibangan flourishing. We have already noted in some details the features of the habitation in this context, we have also seen how the settlers here were practising agricultural and

husbandry activities. We now find that metal and metallurgy had also made its appearance at the site in these early days (C 2900-2700 B. C.).[196] The use of copper tools is attested by the presence of an axe and a *Parasu*. The latter is of a distinctive shape. B. B. Lal points out that it has no parallel in the Harappan assemblage, but examples of this type of tool comes from Mitathal Period II B, Hissar, Haryana and Kurada (Khurdi), District Nagpur, Rajasthan.[197] He also mentions that this type of tool is still used in Rajasthan for cutting scrubby bushes, being hafted at the end of a wooden rod.[198] The above similarities in typology may indicate that the copper metallurgy in the Pre-Harappan Kalibangan had a local origin around Rajasthan-Haryana and was not diffused from Baluchistan, Punjab or Sind. The occurrence of the type at Khurdi, a copper-hoard site is also interesting. A great deal of speculation arises as to the origin of metal and metallurgy, at least in this part of the sub-continent.

Recently, more interesting informations regarding metal and metallurgy has come from Kalibangan. R. C. Agrawal mentions that the excavators of this site, B. B. Lal and B. K. Thapar have personally communicated to him that the Pre-Harappan levels at the site have yielded a rich variety of fifty-six copper objects which included antimony rods, rings, wire pieces, lumps, bangles, pins, arrow-heads, beads, rods, celts etc. R. C. Agrawala points out that such a rich variety and quantity of copper objects have not been reported from any of the contemporary sites, including Mundigak, Saraikhola etc.[199]

The source of copper ore for the Pre-Harappan at Kalibangan is an important question to be considered. Also, in the light of the above information, the idea that copper metallurgy may have had an independent origin in Rajasthan is further strengthened. It is worth mentioning here that there is a general belief among scholars now that the Khetri mines in Rajasthan might have supplied copper ore to the Harappans.[200] As we shall see later the discovery of the

Ganeshwar-Jodhpura culture in Rajasthan leads to further speculations on the lines that perhaps some locally finished copper objects also passed over from Rajasthan sites to the Harappan sites. Recent findings at Ganeshwar[201] have taken the date of this site to the mesolithic times (Period I). Copper artifacts infact begin to come from the Period II which approximately falls arround the end of the fourth millennium B. C. The discovery of arrowheads, fish-hooks, spearhead and awl along with habitational evidences give rise to speculations on the genesis of settled life at the site. The Period III can actually be linked up with the Pre-Harappan phase at Kalibangan. A few hundred copper objects comprising, weapons, tools and ornaments have been recovered. The Kalibangan tradition in metal handling can very well be linked up with this evidence. Kalibangan, which was to witness a flourishing urban civilization in the subsequent Mature Harappan times and was already in the throes of a protourban development, might have had a role in the total operation, if the above theory is substantiated.[202]

Recent excavations at Kunal, Gujarat have not yet been fully reported, However, from preliminary reports[203] it appears that copper artifacts were found in the phase I of occupational level belonging to microlithic-chalcolithic overphase. In Haryana, the Pre-Indus or Kalibangan occupation at Banawali, District Hissar, witnessed the first appearance of copper. However, the metal was scarce. Some bangles of copper have been recovered as well as beads of gold.[204] R.S. Bisht also mentions a partially uncovered house complex with several hearths, ovens and fire—pits in the room. He remarks that excessive fire activity in this area has reddened house floors there. He suggests that it was a workshop, plausibly of a metal-smith.[205]

Coming back to the Indus Valley, we note the rise of the Early Harappan or Kot-Dijian culture at the type-site of Kot-Diji, but metal is very scarce here. Only one fragmentary bronze bangle has been found from this level.[206]

Thus, even before the evolution of the Mature Harappan culture, we find that metallurgy as a technology and the use of metals, especially copper, (silver and gold in rare instances) have been established throughout a wide region from Afghanistan, Baluchistan to the Punjab, Rajasthan and Haryana.

However, in most cases, the implements of metal were quite scarce as far as their occurrence at individual sites are concerned. Moreover, in many cases they comprise luxury items like ornaments. However, evidence for the use of bronze and the awareness of the smiths as to the usefulness of alloying is obtained very early at the Ghar-i-Mar, and therafter at Mundigak — in Afghanistan, etc. The Mehi cemetery and Nal have yielded interesting metal artifacts. The copper mirror from the former is unique and reflects the application of great aesthetic sense into the metal-works on the part of the smith. At Nal not only do we get evidence that may indicate the progress of metallurgy in the region, but the presence of silver objects offers an interesting insight into the conditions of metal-works in the context. We may note here that silver in antiquity could have been extracted either from lead ore or electrum (native gold alloyed with silver). The process of desilvering lead is quite complicated. The process is based on the fact that if fused argentiferous lead is cooled, a point is reached when nearly pure lead seperates in crystals. If crystals of lead were withdrawn by perforated ladles the remaining liquid alloy would become increasingly rich in silver. Now the cupellation technique is adopted to seperate silver, gold and other impurities from the residue lead left in the liquid alloy.[207] Silver would remain free of lead. Both the seperated lead and silver could be made use of. The presence of lead ore at Nal and the occurrence of lead in the copper artifacts from the sites as well as presence of silver objects may indicate that the smiths here were handling the above processes and were extracting pure lead and silver from argentiferous lead ore. Nal has also yielded a number of

utility implements of metal. Comparatively at Balakot we find that although metal was being worked, however, the people were still backward as far as metallurgy is concerned. The evidence from Kalibangan is extremely interesting and when we examine the data from the copper-Hoard sites from Rajasthan we may get a clear picture of the situations in Rajasthan as far as the development of metallurgy is concerned.

But so far our study reveals that the stage was set for more prolific use of metals and the technology of metallurgy in the context of the urban Mature Harappan culture that was to dawn on Sind, Baluchistan, Punjab, Rajasthan, Haryana and Gujarat around the middle of the third millennium B. C.

III

MATURE HARAPPAN

From the outset of the Mature Harappan Period there is greater evidence, quantitatively as well as qualitatively, for the abundant and efficient use of metals. The occurrence of bronze tools at many of the more important Mature Harappan sites suggests that the technology of alloying for bronze had been developed and widely resorted to. Besides copper and copper-bronze, in which the use of tin, nickel, lead and arsenic is evident, gold and silver have also been used, the former appearing to have been used quite frequently in ornaments.

Limited examinations of metal artifacts from the principal Mature Harappan sites indicate that the metal smiths were quite advanced in their knowledge and implementation of techniques of metallurgy. They were most probably employing smelting techniques. D. P. Agrawal mentions that even in the early levels of Mohenjo-daro, sulphide ores (e.g. chalcopyrite) probably were being smelted.[208] Sulpher has to be got rid of by roasting, thus converting the sulphide to oxide.[209] D.P. Agrawal has also pointed out that large

quantities of copper oxide ore from a brick-lined pit from the DK area of Mohenja-daro may indicate its probable use for extracting copper.[210] Incidentally a fragment of a clay crucible with slag sticking to its side has been recovered from Mohenjo-daro. It may have been used for re-melting crude metal.[211] The Harappan smiths of the Mature phase were also deliberately alloying copper ores with lead, tin and also probably with arsenic and nickel.[212] They were also definitely employing the various techniques of metal forging, for example hammering, sinking, raising, spinning cold work, hot work, annealing, joining methods or 'running on', soldering, lapping, wire drawing, open-mould casting and even cire-perdue or lost-wax mode of casting[213] Kilns of bricks have been discovered at a number of places and some of them were probably associated with copper-working. The Allchins cite the example of brick Kilns in block 1 of the DK area of Mohenjo-daro.[214] Most of the metal working evident at the site have to do with secondary manufacture. However, a quantity of copper ore in pieces along with a small piece of lead (alloying ?) have been found near a rectangular pit.[215] But in general only small surface clusters have been documented. Light slag-pieces have been recovered near such surface clusters. This was located in HR East area. Small cluster of bronze, smelting waste, fragments of furnace wall have been detected.[216] Crucibles have been found, totalling to five,[217] one already described above contained sulphide trace. The crucibles were heavily fired with a smooth interior. One piece was thickly coated with sand and clay to withstand heat. Slag was found on the edges.[218] Besides these evidences, there were lumps of unworked crude copper encountered at Mohenjo-daro which were rich in sulphur content. Other lumps were of pure copper. Pieces of copper for recycling were also found in the DK Area. The area definitely housed workshop or workshops of metal smiths.

The main varieties of copper recovered from the different Harappan sites are - Crude copper lumps in the state in

which they left the smelting furnace or slag, with a considerable quantity of sulphur ; refined copper containing trace elements of arsenic and antimony, most probably derived from the original ore ; an alloy of copper and arsenic having from 2 to 5 percent of arsenic, probably present as a natural constituent of the ore ; and bronzes having a tin alloy, lead alloy and in a very few cases nickel alloy.[219]

The excavations at Mohenjo-daro reveal that metals, viz., copper, and lead and tin as ingredients in copper, and silver and gold were in use from the earliest strata excavated. Copper was the most useful metal at their disposal for general purposes. Copper objects comprise domestic utensils, axe-heads or celts, daggers, knives, lance-heads and arrow-heads, sickles, statuettes, bangles, finger-rings and ear-rings, amulets, wires, rods, etc. The bronze objects discovered at Mohenjo-daro comprise utensils, tools and weapons, stauettes and jewellery. Sana Ullah points out that most of the bronze objects were made by casting, but some had to be shaped and finished by hammering.[220]

Sana Ullah points out that use of bronze besides copper for utensils at Mohenjo-daro indicates a great advance in metal working.[221] Copper is an ideal material for making household utensils owing to the metal being so ductile. But unless it is fairly thick it is apt to bend and dent, especially if the temper produced by hammering is destroyed by heat as when the vessels are used for cooking. Bronze, on the other hand, has the disadvantage of being considerably less ductile but a finished vessel of this material is considerably stronger and less liable to damage. Sana Ullah also points out that many of the metal utensils have their counter-parts in pottery.[222] E. J. H. Mackay has also drawn parallels between pottery vessels and metal utensils. It is likely that the former provided models for the latter. The ribbed ware in pottery has been copied in a metal jar.[224] In case of pottery this occurred when a vessel was made in two portions which were subsequently fitted together before firing, the rib being

caused by the projecting edge of the lower portion being lapped over the upper portion of the jar[225] Sana Ullah points out that only those metal vessels the shape of which were difficult to obtain were made in this way. The vessel or jar mentioned above is obviously a copy of the old pottery pattern and was without doubt shaped from a single sheet of metal.[226]

Sana Ullah also mentions the examples of nos. 4 and 5 in PL. CXL and states that these vessels prove that the art of casting bronze was a well-established industry at Mohenjo-daro.The primary technique employed was that of hammering sheet metal. However, solid casting chisel edging bending of the rims were also done. There are dishes and covers with handles which are cleanly made and must have been either carefully rubbed down or trued up on a lathe. He states that though there are no lathe-marks visible, but these could have been removed by subsequent honing and polishing. In no. 5 handle was secured to the cover not only by a rivet but also by pouring molten metal around the base of the rivet for additional security.[227]

Copper and bronze as well as silver vessels were found together in several cases. Sana Ullah mentions three groups of vessels. Group I (C 1978) comprising three vessels, two copper and the third a bronze. With these some discarded tools were found, some broken and bent, made of both copper and bronze. However, they come from Late Period at Mohenjo-daro. From the same period comes the second group of vessels, two bronze and two copper (PL. CXL. 4, 5, 9 and 18). Group 3 (HR 4212a) comprise two silver jars and one of bronze. (PL. CXL. 2 and 3, PL. CXL.1, 13). Associated with these are a number of copper and bronze implements of various kinds.[228]

Besides these bronze and copper jars and vessels, a number of other sorts of implements have been recovered, for example a censer similar in shape to the offering stands of pottery (E 2044) in PL. CXL. 1, 5 ; pieces of copper shaped like mussel-shell (E 2045, HR. 3941), one illustrated

in PL. CXL, 12 ; and a twisted piece of copper probably the handle of some utensil. Among the utensils we come across, bronze cast bowl, vase, vessel with cover in copper, dish and cover of cast bronze, bronze flask, jar-cover in very thin copper sheet, bronze cover, copper bowl and pan.[229]

A few silver vases have also been recovered from the DK and HR areas. All of these were found to contain some gold jewellery and in one case silver jewellery also. The first example (DK 1341) is a fine silver vase with a cover illustrated in PL. CXL. VIII, b. Another (HR 4212a) is a small cast silver vase. The third (HR 4212a) is a vase raised from a sheet of silver with a flat base and is of simple make.[230]

We have noted that silver extraction and metallurgy was probably already being practised by the inhabitants at Nal in Baluchistan. Therefore, it is not surprising to find silver objects at Mohenjo-daro. However, it is evident that this metal was quite scarce in the Indian sub-continent for even at Mohenjo-daro and Harappan the evidence for the silver is very rare.

A lot of metal weapons have been recovered at Mohenjo-daro. As Sana Ullah points out, 'in every case these implements are of substantial make and there is no skimping of metal'.[231] Among these implements are blade axes[232] of long and narrow[233] and short broad[234] varieties, spear and lance-heads,[235] arrow-heads,[236] knives and daggers.[237]

Blade axes[238] may have been used in war as well as for ordinary purpose like cutting and digging. They were probably set in a split handle at right angles to it and secured by lashing of raw-hide. Sana Ullah suggests that for carpentary these blade axes may have been hafted differently. In one case both the ends of the tools are sharp-edged and therefore, it may have been used as an adze, for it has a true chisel-edge.[239]

Copper is more commonly used for making blade-axes than bronze.[240] This may indicate the infrequent use of the

method of alloying as well as the scarcity of alloy metals like tin and lead. It is probable that these simple axes were first cast in open moulds and then hammered to give them the requisite hardness. The bronze blade-axes would have required very much the same treatment. In case of the copper axes the absence of hammer marks suggests that they were carefully rubbed down after being hammered. However, in case of the bronze ones cleaner castings could be obtained and therefore not much hammering would be required to harden them. Their tin content would serve this purpose.[241]

Sana Ullah points out that some very early blade-axes from Susa, with slightly played edges and straight sides and butts approach very closely to the Mohenjo-daro blades of long and narrow type. He remarks that this is to be expected for there are numerous indications of connections between ancient Elam and the Indus Valley civilization.[242]

Sana Ullah with some hesitation identifies the spear and lance-heads at Mohenjo-daro.[243] There are traces of wooden handles or shafts in which these were fixed once. He points out their complete disappearance may prove that they were made of wood. He also points out the extreme thinness and width of the blades. He suggests that these blades were strengthened down their axes by the use of bamboo like wood of tough exterior as handles or shafts into which the blades were perhaps fitten. It is probable that the portion in the shaft that took the blade 'was sawn down longitudinally instead of splite, so that the sides of the bifurcation might grip snugly along the blade, acting as a kind of midrib on either side'.[245]

The blades seem to have been made of metal which were probably cast. Hammering was employed to bring them to shape from the region of the tang.[246] Sana Ullah suggests, judging from the slight irregularity in the edges of some of the blades, that they were sometimes sharpened up with a hone to remove burring and notches. He also points out that in general shape these spear-heads resemble those used in parts of Africa still in this century.[247]

According to Sana Ullah these large thin spear-blades were not made by the Harappans at Mohenjo-daro but were trophies they captured from a people of inferior culture who may have been living in the Sind at the time. The poor resources of these inferior people would have compelled them to use metal as sparingly as possible and hence the thinness of the blades. For, as Sana Ullah points out, the Harappans did not use metal sparingly in case of the blade-axes, and the spears in order to be effective weapons had to be as weighty as the blade-axes.[248] However, we cannot as yet accept this theory without further consideration for the historicity of such incidents having occurred. The only established link perhaps existed with the chalcolithic cultures in the Rajasthan which were contemporary, like the Ganeshwar culture. The link with Kalibangan has been established. However, the lesser culture higher culture syndrome may not have operated exactly as Sana Ullah surmished.

Only one specimen of arrowhead has been recovered from Mohenjo-daro (DM 61), which was evidently cut from a piece of sheet copper. A few examples of knives and daggers, mostly in copper have also been recovered. (Pls CXXXV and CXXXVII).[249] There is a piece of bronze (HR 4212a) illustrated in PL. CXXXVIII, 9, which may have been intended for a knife. Another, made of copper, may possibly be a leather-cutter since its tip is curved.(HR 4057) illustrated in PL CXXXV, 6.[250] Knives were primarily used for cutting while daggers were shaped as blades of different types ; leaf-shaped broad, curved hollow-backed, double-curved etc.

Among the other utility implements in metal that have come from the site are razors,[251] saws,[252] fish hooks,[253] a sickle-shaped blade,[254] chisels,[255] needles,[256] awls and reamers and metal rods.[258]

The two specimens of razor are made of bronze (PLs. CXXXVII and CXXXVIII). The first example (VS 3054), illustrated in PL. CXXVIII, II, has a fine curved edge. There

are two holes at the back by which it was riveted to a handle. The second example (L 238), illustrated in PL. CXXXVIII, 5 is of another kind with a sharp curved edge and rectangular section.[259]

Sana Ullah points out that the fine bronze saw (C 100-1) illustrated in PL. CXXXVII, 7 and also in PL. CXXXVIII, 8, is of the same shape as the iron saws used in modern day to cut up shell. There are two holes in the tang for riveting each at a distance of 1.4 inches from the other which indicates that the handle was of considerable width.[260] The teeth are well-preserved at the tip of the saw, but are somewhat irregular. Another portion of a bronze saw is illustrated in PL. CXXXVII, 6 and also in PL. CXXXVIII, 4. No teeth are now visible.[261]

As to the sickle-blade, Sana Ullah suggests that from the curvature of the object (VS 1802), which is 4.7 inches long and 1.05 inches wide, it may be concluded that it was portion of a sickle-blades. It is made of copper. He also points out that the inner edge of this fragment of blade is of thicker metal than the convex side, towards which the metal fines down to a sharp edge, indicating that perhaps the outer edge must have been used for cutting.[262]

Two fish hooks made of bronze have been found in the DK and HR areas (DK 4140, HR 3312).[263]

The few metal awls and reamers have come from the HR, SD and VS areas. Some of them are made of copper and some of copper antimony alloy.[264] The needles at Mohenjo-daro are made of copper.[265]

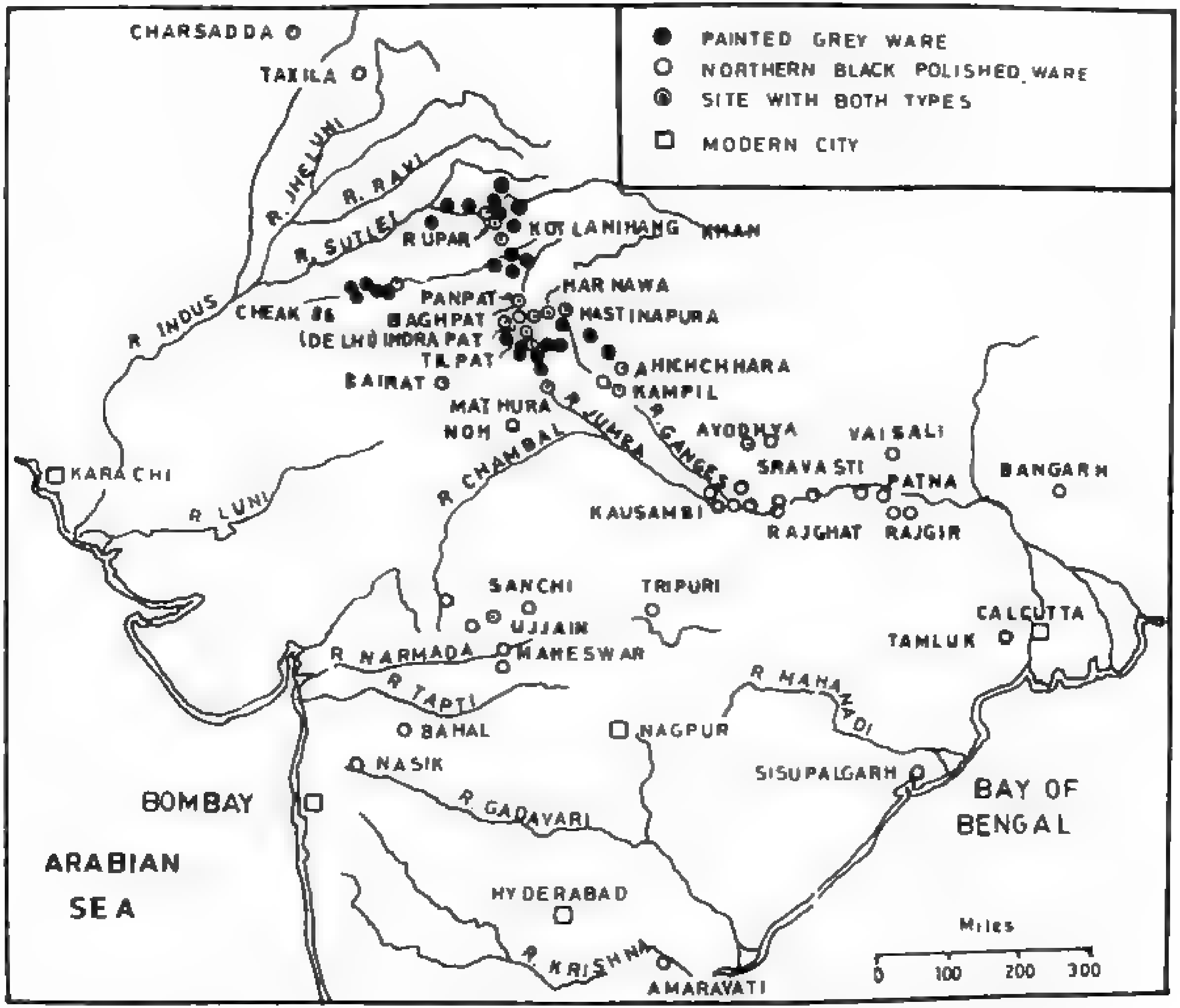
A number of metal rods made of both copper and bronze, are mostly round in section.[266] The use of these copper and bronze rods is uncertain. Sana Ullah suggests that probably they were used for applying cosmetics like the kohlstick as in ancient Egypt. Their blunt ends indicate that they could not have been used as awls. Moreover, the usually carefully rounded and polished ends indicate that they are not pieces of unused metals.[267]

The metal chisels[268] are of three types, for example, (a) rectangular or square in section with dimensions very much the same along the entire length ; (b) rectangular or square in section with flattened tangs ; and (c) round in section. Numerous examples have been recovered, which are mostly made of copper and rarely of bronze.[269]

Chisels of the first type were made from square or rectangular rods of metal which were probably cast in this shape, for, as Sana Ullah points out it would have required considerable labour to hammer them out. However, the intentional thining toward the butt edge was probably produced by hammering, for both the butt and edge would have required the additional hardness that in a copper tool can only be achieved by hammering.[270] The shape of this type of chisel is common to most early civilizations.[271]

However, the second type of chisel seems to be confined to the Indus Valley civilization. The long flattened shanks appear to have been fixed to handles. This type of chisel could also be used without a handle. Chisels of the third type were probably used only for working stone.[272]

Beside the above mentioned utensils and implements, copper and bronze were used by the Mature Harappan folks at Mohenjo-daro for personal ornaments also. Finger rings of copper and bronze, often made of fine wires have been recovered from the DK and HR areas, and are illustrated in PL.(XLII).[273] An earring of unusual shape made of bronze wire passed through beads was found in the HR area.[274] Bracelets are all made of copper. Most of them have tapered ends which often overlap. They are all found in the HR and L areas.[275] A number of copper and especially bronze terminals, spacers, beads, chains and buttons have also been recovered from the site.[276] A bronze mirror[277] with a handle, rectangular in section has been reported by Mackay. It is slightly oval in shape with a plain back. The polish, which was definitely there, has disappeared. The edge of the face of the mirror is slightly raised perhaps to save the polish on



MAP-XIV Map showing the distribution of the Painted Grey and N B P Wares

the face. The mirror is very heavy. The tradition of mirrors has already been noted earlier. Other objects of household use found were a bolt, a plumb-bob and another scale pan and beam, all reported in the later report by Mackay.[278]

Metal sculpture from Mohenjo-daro is represented by the copper bull, roughly modelled with lowered head and a marked hump. The animal is a solid casting. It stands on a pedestal with a ring beneath.[279] Another copper model of an indeterminate animal (HR. 4363) comes from the HR area. The long snout suggests that it may have been an elephant. It is roughly cast.[280] A model of a bird was made in hollow copper casting. The eye-holes appear to have been drilled.[281]

But the most remarkable piece of sculpture is the bronze figure of the dancing girl which is so famous. It was found in the HR area, 6 ft. and 4 in below surface, belonging to the middle levels.[282] D. P. Agrawal points out that the cire-perdue method of casting was definitely employed in the making of this figure.[283] The Harappans at Mohenjo-daro possessed substantial amount of gold and silver jewelleries. These metals were by no means rare. Pure gold as well as electrum have been used by the smiths for making jewellery.[284] It may have been that silver and gold were seperated from electrum. Forbes states that seperation of silver and other impurities from gold was invented possibly during or shortly after Ur III period (C 2200-2000) B. C.). But it took centuries for the method to become common.[285] However, at Mohenjo-daro electrum is evidently used quite early. Yet, it may have been that the silver that the Harappans used came from argentiferous lead and perhaps not from electrum, if Forbes' view is accepted. Since gold occurs in metallic state, the gold is simply melted and cast into requisite shapes after mining. In case of alluvial deposits, the sand and gravel are agitated with water in pans. The rocky material is floated off and gold particles are collected at the bottom.[286] Alternatively, the alluvial sand was passed through agitating cradles or sluices, provided with obstructions to retain the gold on the

other side of the sluice. The lighter sand is washed away. Gold particles, whether obtained from alluvial washing or separated from reef gold, were fused into small ingots in clay crucibles over charcoal fire. For this, a temperature of 1063°C would have been necessary,[287] which is a little lower than the temperature required for melting copper (1083°C).[288]

Coming to the gold and silver ornamental objects found at Mohenjo-daro, we note that they comprise of various types of beads, spacers, terminals and among larger ornaments, necklaces, of semi-precious stone-beads and gold beads, often with pendants, gold and silver bracelets, a silver ring, earrings or nose-studs of glod and silver and bangles of gold and silver.[289]

The barrel-shaped beads, oval in section are found in considerable numbers at all levels. They were of both gold and silver. The disc-shaped fine beads of gold occur in a fine specimen of jade-beads necklace. Minute gold globular beads have come from the DK and HR areas. Larger globular beads of gold, silver, copper and bronze were sometimes cast and sometimes beaten out of thin material and soldered together. These occur at all levels.[290] Spacers and terminals, used in necklaces and bracelets were made of gold, copper and bronze. Often thin gold wires were used in necklaces to attach the beads to the cord of the necklace.

The intricacy of the ornaments and the different modes used in the making of these ought to be emphasised. We would like to give an example here. The gold bracelet (HR 4212a (e) in jewellery hoard no. 3, shown at the top of the P1. CXLIX, no. 3,[291] may illustrate how intricate the ornaments were. The bracelet has been reconstructed from a number of loose beads. The gold spacers found with these beads show that they were originally threaded in six rows. The ends of this piece of jewellery are finished off with hollow, flattened, semi-circular terminals of gold, through a small hole in the outer edge of this the threads of the bracelet passed. These small beads were cast, and the spacers cut

out of sheet metal. The terminals must have been beaten out of thin sheet gold, as there is no trace of soldered edges, and then pressed flat.[292] Thus we note that several modes of works had been employed in the manufacture of each piece of jewellery. There is no doubt about the skill of the Mohenjo-daro jewel-smith.

As Mackay points out, silver was used more freely than gold at Mohenjo-daro. Mackay also suggests that as lead is by no means rare at Mohenjo-daro, it may have been that silver was extracted from the argentiferous galena.[293] He also mentions that a small trace of lead was found in a silver sample examined by Dr. Hamid. This sample (DK 5774) was obtained from the DK area and belong to an indeterminate period. Dr. Hamid suggested that the cupellation process may have been employed for extraction of silver from the ore. The small amount of copper present in the sample may have been due to adulteration.[294] Incidentally, a sample of lead (DK 6314) was also found at the DK area. Dr. Hamid's examination showed that it contained no trace of silver.[295]

We may note that two silver bracelets, a silver ring with bezel, with the evidence of the bezel being soldered to the simple strip-ring,[296] a quantity of silver beads,[296] two silver bangles (DK 1341)[298] and a couple of silver earrings made of wire, roughly bent with the ends overlapping,[299] comprise the ornaments of silver. Besides these, we have already noted the occurence of the above jewellery were found.

Thus Mohenjo-daro attests the fact that the Harappans of the early days had begun to handle the basic processes of copper-bronze, gold and silver metallurgy. These developed through the times and the intermediate and Mature phases saw a flourishing state of the metal industry. The smiths were quite efficently handling the sophisticated processes of the metal extraction as well as the techniques of hammering, forging, lapping, melting and casting. Mackay[300] emphasises the point that at Mohenjo-daro bronze was known and used

by people from early occupational levels. The abundance of the metal artifacts, the appearance of the copper-bronze alloy, as well as gold and the quite substantial use of silver, all reflect a degree of affluence and organisation as far as the collection of the raw materials for metal industry are concerned. A wide net-work of the trade and a busy commerce are indicated which is proved to have been very much in vogue by several evidences. The amount and quality of metal works also indicate a crafts-specification being in existence. The metal smiths had to devote their entire energy and time to their special crafts. As we have noted again and again the conditions were set by the efficient handling of the agricultural economy which provided a large surplus that freed these smiths of the worry for sustenance. The evidence of the jewelleries at the Mohenjo-daro also indicate how much affluent and stable the state of economy was, so that so much effort and value were given to the manufacture of luxury items, perhaps for the hierarchy only. If the gold really came from the gold mines in far Karnataka, there is no doubt about the wide trade organisation at the disposal of the Harappans at Mohenjo-daro. In fact, as the spectroscopic analysis of the copper ores used by the Harappans show, the Rajasthan copper mines had probably supplied a large amount of ore to the Harappans in the Indus Valley and Punjab, Haryana, Rajasthan and Gujarat. As we shall later note in some details, a local chalcolithic culture had emerged in Rajasthan which was contemporaneous with the Pre-Harappan — Mature Harappan cultures. Recent findings indicate that these chalcolithic people in the Rajasthan may not only have extracted the copper from local deposits and exported them to the Harappans, but also some finished objects were probably similarly exported. If this is true, there remains no doubt about the wide overland trade-nexus running throuhout these regions in the Harappans times. Moreover, if copper, tin, silver and lead came from Afghanistan, extreme west Baluchistan, Persia, etc., than the wide network of commerce appear to have helped the

metal industry a lot. The picture is of a highly developed, rich, organised and stratified society where division of labour and craft specialisation were being practised. Moreover, the fact that most of the metal artifacts appear to be utilitarian in nature indicate that the metal industry was catering to the local daily requirements of the common householders quite in earnest. Thus the metal industry had evidently been playing a role in the economy.

Similar metal artifiacts have been recovered from Harappa and Chanhu-daro in Punjab and Sind, respectively, of the Mature Harappan context. For example, these sites have also yielded copper and bronze utensils like the jars from both Harappa and Chanhu-daro dishes and a cup from Harppa ; handled pans from Chanhu-daro similar to those from Mohenjo-daro. The copper canister fitted with wire loop handles from Chanhu-daro is reported to be the only example of a handled metal vessel of the Harappan Culture apart from the handled pans mentioned above.[301] Besides this, the scale pans and beams of metal have been found at Chanhu-daro in quite a few numbers. They are all simple dishes of beaten work and in some cases have become considerably thicker by metallic deposits. Occasionally the three holes by which these pans were suspended are still to be seen, but often they have become blocked up and cannot be traced now. But curiously enough, none of the beams have been found with a hole in the centre to take a suspension cord or chain. All these beams have slightly thickened ends to prevent the strains which held the pans from slipping off.[302] Mackay has also reported the finding of a corroded object at Mohenjo-daro which he also identified as a scale beam.[303] Harappa has also yielded a beam of a weighing scale quite similar to those from Chanhu-daro. It is made of bronze.[304] Among the utensils a silver vase has also been recovered from Harappa, small in size, open-mouthed with a well defined base and thick rims. It shows marks of hammering both inside and outside. It has been found in Areas J. Stratum V.[305]

Among the metal weapons are the similar blade axes, long and short, from both the sites. The lower part of an axe from Harappa may have been socketed (12393). The broad edge of this is still very sharp and dented. It is not of bronze and has been recovered from Mound AB, Stratum VI.[306] Adzes, spear-heads, barbed arrow-heads without tang also occur at both the sites as at Mohenjo-daro. However one unique example of arrow-head without barbs has come from Chanhu-daro. Its tang is broken. Mackay suggests that it may once have resembled an arrow-head found at Ghazi Shah. Dagger knives, often with a vertical mid-rib at Harappa as at Mohenjo-daro, come from both the sites.[307]

Among other implements of daily use were the various types of chisels found at both Chanhu-daro and Harappa. All the categories of this implement as noted at Mohenjo-daro were present at Chanhu-daro also.[308] Sana Ullah has categorised the chisels found at Harappa, viz., (a) Chisels with flattened shanks ; (b) Small and strong chisels with burred butts used for cutting metals or dressing stone ; and (c) tanged chisels. Of these, as we have noted, the first two varieties were quite common at Mohenjo-daro. The same was true of Harappa. Only two examples of the tanged chisels have been recovered from Harappa.[309] Saws have also been recovered from both the sites,[310] one from Harappa being quite similar to the Mohenjo-daro example.[311] Besides these, fish-hooks have been found at both Chanhu-daro and Harappa.[312]

The last site has also yielded several other interesting implements of metal, viz., knives and sickles, scrapers, gouges, nail parer, needles, pins, antimony rods, and cobbler's aw1.[313] Besides all these a copper mirror has also been retrieved from the stratum II of Mound F at Harappa. It is oval in shape and has a long tang (12748).[314] M. S. Vats points out that the gouges recovered from Harappa were used for hollowing out, grooving or ribbing wood, bone, ivory and stone. All of these are of bronze.[315] He has identified the nail

parer from Harappa with those used in the Punjab in modern times.[316] The specimen no. 32 in PL. CXXV (Vol. II) appeared to Vats to have been a cobbler's aw1, made of a bar rectangular in section. Near the point of the aw1 is a slight inward cut, perhaps for putting the thread through the leather. The butt-end of this tool appears to have been let into a handle.[317] The needles from this site retain vestiges of the eye, as those from Mohenjo-daro.[318] One of the antimony rods from Harappa appear to have been a stopper-rod crowned with the motif of a dog biting the ear of a goat.[319] This is very interesting and reflects the creative instincts of the Harappan smiths that some time come out of the manufacture of mundane, everyday objects. Also interesting is the toilet or surgical set recovered from the Mound AB at a depth of three feet below the surface. Illustrated in PL. CXXV, No. 1,[320] this consists of a bunch of three bronze instruments held together by their looped and interlaced ends. Among these were a double-edged knife, a pair of pincers and a piercing rod.[321] Coming to some of the specific objects from Chanhu-daro, we find that awls have also been recovered from Chanhu-daro as from Harappa and Mohenjo-daro. At the former site they are of two types, viz., (a) rectangular or round in section, rounded at one or both ends; (b) round in section. Mackay suggests that some of the awls of type (b) might have served well as pins for hair or for fastening a cloak.[322] The specimen illustrated in PL. LXVII, No. 8 has been identified by Mackay as a spatula from its shape and thinness. He suggests that it would have been useful in preparing fatty cosmetics or colours.[323] The shovel, as Mackay points out, is very modern looking and is the first specimen of its kind that has appeared in any of the Harappan sites. It has a plain, flat handle which is of one piece of metal. The pan of this handle has no rivet holes. However, the handle is too short to have been used without a long attachment, probably of wood. Possibly the tool was hafted into a wooden handle. Mackay suggests that it may have been used in lifting charcoal or grain.[324] The examples

of a new type of tool illustrated in PLs LXXX, Nos.1-8 and XCIII, Nos.12, 13 have been found in a room with a number of beads of minute size and Mackay points out that it appears that these tools were used in the manufacture of the beads.[325] He points out that Mr.William J. Young of the Museum of Fine Arts Boston, has come to the same conclusion after examining the specimen, Nos. 6 and 7.[326] Lastly, we must mention that a bronze (judging from its colour) ingot has been recovered from Chanhu-daro. Mackay reports that numerous metal objects were found associated with this ingot.[327] Besides this, small masses of lead of irregular shape were found in various parts of Mound II.[328] Putting the last two findings together, it may not be wrong to assume that here is an indication of alloying bronze with lead at Chanhu-daro.

The metal industry of the Harappans had reached a level of finery and skilled craftsmanship which is exemplified by the copper and bronze miniature chariots found at Harappa and Chanhu-daro. We may note that these objects, had no utility value and may have had, at best, a religious significance. It is also likely that they were just objects of pleasure, play and display of the richer section of the society in these two metropolises. But the skill wtih which they have been crafted and the great attention paid to the details in their execution is remarkable and reflect the high level of perfection reached by the metal-smiths. The theory of religious use for these objects is more probable, especially, keeping in view the Late Harappan Daimabad findings, as we shall see later. The copper chariot from Harappa was recovered from Mound F Stratum IV. It is an extremely delicate miniature and is two wheeled.[329] The small miniature chariot, that has been reconstructed from numerous fragments, is open both front and back and has a gabled roof. The side walls and the roof exhibit a simple linear decoration. A figure of a human driver is seated in front of the chariot on a raised seat. However, the poles, the wheels and the axles as well as the animal supposed to be driving the chariot, are all

missing.[330] As Vats points out, this is the first example of a covered chariot from the Indus Valley. Moreover, this find antedates the earliest use of a wheeled vehicle in Egypt by several centuries.[331]

The Chanhu-daro examples are probably made of bronze.[332] The first of these is nearly perfect but the front of the car has bent upwards. Its frame has six cross-bars. The sides of the car consist of an upper and lower bar connected by uprights at each end. It displays a figure of a human driver holding a stick in his right hand. It also has wheels which are solid and lack the projecting hub of some of the pottery wheels. The wheels must have revolved in two axle-brackets that have been cast with the frame.[333] The second example consists of a "ekka" of modern India. The under-frame was curved and had four crossbars. Each side there were supports for a pent-roof at each end. A transverse cross-bar at each of the cart kept these canopy supports upright. The pent-roof may have been a wooden frame covered over with a matting or cloth.[334] There can be little doubt as to the fact that wheeled vehicles, similar to these models actually traversed these regions.

Like the rich and fashionable populations of Mohenjo-daro, the well-to-do people at Harappa also used ornaments of gold, silver and copper to adorn their persons. Silver and gold beads the latter in quite an impressive amount, have been encountered at Harappa. The most common variety of beads was the tiny gold ones of round shape.[335] Besides these, golds was used for capping and for terminals in necklace made of semi-precious stone-beads. Beads of silver and copper were usually of small size, the former globular in shape, the latter globular and cylindrical as well.[336] Gold consisting of flat strips, straight or segmented. were also used in the necklace.[337] Terminals of copper and bronze were also used besides gold.[338]

Besides these small pieces used in ornaments, a hollow armlet,[339] a hollow elliptical bangle,[340] a conical ornament

for the forehead[341] - all of gold, and a heart-shaped pendant of gold inlaid with blue faience,[342] etc., have been recovered. A necklace consisting of 240 round gold beads in four rows[343] and two wristlets, each consisting of 69 round gold beads arranged in three rows[344] have also been recovered.

Silver is rare. The finds include one hollow fragmentary bangle,[345] a number of silver beads lumped together,[346] a tiny conical boss of silver designated as temple ornament,[347] a silver bezel soldered on a copper ring for finger,[348] bracelets[349] and a brooch which consists of a strong, flat silver plate to which are soldered three bands of gold symmetrically bent so as to form the figure '8' which is then inlaid with two rows of tiny steatite beads.[350]

We may note that the gold-smiths at Harappa had learnt the art of soldering in case of gold and silver. H. Beck also pointed out that in case of some soldered gold beads, the colour indicates that they were made with the addition of a little copper.[351] We also get a clear evidence here that the Harappans were extracting pure silver from lead. Mohammad Sana Ullah is reported to have pointed out that the silver bangle noted above is made of almost pure silver free from lead and contains only a slight impurity of copper.[352]

However, excavations at Chanhu-daro indicate that perhaps here the population were not enjoying the possession of the precious metals-gold and silver. The jewellery of these metals, even of the simplest description, are entirely absent, although occasional fragments of gold foil were found adhering to copper beads and bangles.[353] As Mackay points out, the exceptionally fine jewellery found both at Mohenjo-daro and Harappa has no counterpart at Chanhu-doro.[354] He suggests that from the way the people lived at this site and the fact that they were chiefly engaged in crafts of various kinds one can hardly expect them to have worth any thing that was exceptionally rich or precious. He points out that it was their less affluent condition compared to the people at Mohenjo-daro and Harappa, than any lack of expertise in

the manufacture of jewelleries, that was responsible for the absence of these objects at Chanhu-daro.[355] For, as Mackay points out, the copper and bronze ornaments that are available at this site, amply prove their skill in this direction. The jewelleries from Chanhu-daro comparise copper and bronze bracelets,[356] copper or bronze rings,[357] copper conical fore-head ornaments,[358] copper wire beads,[359] sixteen beads of copper or bronze.[360] The metallographic evidences of the lumps and traces recovered at Harappa indicate the presence of arsenic and arsenic-rich minerals. A piece of arsenic has been found in Mound F from Sq K and a small lump of lollingite was found in a jar.[361] Terracotta crucibles were recovered one of whom was found near a furnace in Mound F. The contents of this crucible show that it was used for melting bronze .[362] Besides these numerous pieces of copper which might have actually been collected for working have been recovered from Mound AB. A number of furnaces have been discovered in Mound F at Harappa[363]

There were three varieties of furnaces discovered . One was a pottery jar furnace embeded in the ground with marks indicating contact with fire. There were two more which were in the nature of cylindrical pits dug in the ground with evidence of fairly intense firing. At one of these there is even evidence of a slanting flute to serve as air channel. We may refer to the theory of Tylecote mentioned above concerning ancient furnaces at Timna. D.P Agrawal's view has also been referred to previously in this conection. Besides, thirteen pear-shaped pits have been located dug in the ground, some with columns.[364] However, the recent excavation reports from Harappa indicate that the pear-shaped pits may actually have been used as ceramic Kilns. However, metal workings may not have been limited within the city-complex of any of these metropolises. Hence, the paucity of evidence for local smelting do not indicate a total import of metals and metal objects.

At Chanhudaro in fact, unfinished castings were noted.[365] Mackay has observed that these were presumably

intended for manufacture of an implement. A bunshaped ingot has also been discovered.[366] The finding of the three metal hoards at Chanhudaro from Locus 284, Locus 210 and 297 might indicate these areas to have housed craftsmen's quarters. However, no indication of furnace pits are forthcoming. In the circumstances we infer that most of the heavier processing techniques were handled outside the city area and the pieces were then brought in for finishing.

The above evidences may indicate that the economic status of the populations of the major Harappan metropolises was not always the same. While the metal repertoire of the three cities of Mohenjo-daro, Harappa and Chanhu-daro, would indicate that the copper-bronze industry was flourishing at an equal rate at all these three metropolises, the jewellery assemblage indicates that the population at Chanhu-daro were perhaps of a poorer status than those at the other two metropolises, as far as personal possession of materials went. If what Mackay suggests is correct that the inhabitants of Chanhu-daro were mainly engaged in crafts, it would throw an interesting light on the background of the activities and professions of the Harappans, the social denominations, locational motivations and conception of importance of the various jobs and crafts. At Harappa and Mohenjo-daro the clear evidences for the existence of an administrative and / or a priest class brings a picture of a variegated society.

A survey of some of the smaller Harappan sites may provide a clearer picture of the different categories of settlements that existed and the various economic classes and groups who all comprised the large, rich, complex Harappan society.

At Kot Diji, for example, we do not encounter such a prolific metal industry. The Mature Harappan levels yielded fine axes, arrow-heads, chisels and few bronze bangles.[367] On the other hand, at the Mature Harappan site of Allahdino, near the Malir channel, approximately ten miles east—northeast of the confluence of the Indus and the Arabian sea, there has been the recovery of a surprisingly

large number of metal objects. J.G. Shaffer mentions that over a thousand pieces of metal including both definable and indefinite objects have been found here. The definable objects include both functional and luxury items.[368] He also mentions that some examples of gold and silver objects have also been identified.[369] Walter, A. Fairservis memtions that 196 pieces of copper or bronze, have been recovered from the site.[370]

At the small site of Balakot also we note a surge in metal working in the Harappan period compared to the earlier Balakotian times that we have seen. Dales mentions that the studied samples from this context include twelve scoriae and prills of copper and fifteen copper fragments of pins, beads, rings and small flat plates. More interesting is the discovery of three fragments of pottery crucibles with adhering patches of copper dross.[371] This indicates that smelting and melting of metals had been carried out at the site.

We have already noted that the copper industry was flourishing in the Pre-Harappan contex at Kalibangan. In the Harappan context the richness of the copper artifacts is all the more evident. B.B. Lal meantions that except for the long blades of chert, that he suggests, may have been used as harvesting tools, the tools and implements at Kalibagan were made of copper.[372] R.C. Agrawala mentions that about twelve hundred copper objects have been recovered from the Harappan levels. They include chisels, awls, fish-hooks, axes, blades, nails, drills, spouts, needles, razors, celts-which may have used as tools ; arrow-heads, spearheads, knives, daggers-among the weapons ; and pins, bangles, beads, mirrors, earrings, rings-among the toilet and luxury items.[373] Beside these, the figure of bull in copper[374] is especially note-worthy from the point of view of its excellent artistry. B.B Lal meantions that the expression of the charging bull has been captured in the model with great skill.[375]

Kalibangan with its 'Citadel' and 'lower city', its mudbrick structures and fortification walls, baked brick drains, wells

and bathing platforms, grid patterned streets running north-south and east-west, with a flourishing farming and husbandry economy, was truly experiencing the amenities of the urbanity that was taking shape everywhere in the zone of the Harappa culture in the major metropolises. The development and progress of metal industry in the total economic fabric was an inevitable part of that urban experience as we have noted at Harappa, Mohenjo-daro and Chanhu-daro.

However, B. B. Lal mentions that examination of nearly twenty metal specimens from Harappan Kalibangan has revealed that, here, there seems to have been no attempt made to 'deliberately' add tin to copper to produce bronze. The small quantities of tin present in a few of the specimens are to be regarded as impurities in the ore.[376] We have already noted that the Pre-Harappans at the site had possessed a large assemblage of metal objects. We do not have report or information as yet as to the metallic content of these copper objects. But there is a possibility that an examination of these objects will also reveal the same fact. We may note here that D. P. Agrawal mentions that tin is absent in the copper objects from Ahar.[377] R. C. Agrawala and Vijay Kumar also point out that an examination of some copper celts from the OCP site of Ganeshwar at the Chemical Laboratory of the Geological Survey of India at Jaipur revealed that these contain only a nominal quantity (.01%) of tin.[378] Therefore, it may have been that copper as well as copper metallurgy of the Harappans at Kalibangan were obtained from the early non-Harappan Chalcolithic sites in Rajasthan near the Rajasthan mines, as we have seen in the case of the Pre-Harappans at Kalibangan.

The Harappan sequence at Banawali, Haryana yielded the typical copper objects, viz., arrow-heads, spear-heads, a fragmentary sickle blade, the typical razor, chisels, ring, double spiraled and simple pins, ear/nose rings and fish hooks.[379] Incidentally, it is interesting to note that this site is quite rich in gold. Goldplated terracotta beads were found.[380] A large

house excavated at Banawali yielded numerous beads of etched carnelian, gold and lapis lazuli. This house may have belonged to a jewellery dealer.[381]

In Gujarat, at Lothal also we note that the Harappans were using some of the typical metal implements described above. For example D. P. Agarwal mentions that here also we note the occurrence of the same thin spear-heads and arrow-heads like those at Mohenjo-daro, Harappa, Chanhu-daro and Kalibangan.[382] Besides these, the Harappans at Lothal also used copper axes, razors, knives, celts, fish-hooks[383] and chisels.[384] Luxury items like ear-rings, rings, bangles, pendants and beads were also often made of copper and even copper-bronze.[385] S. R. Rao reports the occurence of a damaged bronze shaft-hole axe at Lothal, similar to the single specimen of this type obtained from the late level of Harappan occupation at Chanhu-daro.[386] S. R. Rao mentions that at Lothal a high percentage of tin was used in making bangles and pins rather than in the production of tools and weapons. A bangle and a pin showed to have had 11.80% and 13.80% of tin, respectively, while a spear, engraver, rod, chisel and a mirror contained 2.27%, 3.96%, 9.02%, 9.62% and 5.47% of tin, respectively.[387] Rao points out that too high a percentage of tin makes the weapons brittle and therefore less effective.[388] Moreover, he also points out that in general the Harappan copper smiths gave the offensive weapons a 'very low priority both in the technique of casting and the use of alloys'.[389] It may be suggested here that more than a case of priority, it was the scarcity of tin that restricted the copper smiths to its use in the making of small and costly luxury objects only. The weapons and tools, were standardised and made in more numbers and therefore could not be alloyed with tin. Here, we may also point out that, as far as metal artifacts from Mohenjo-daro and Harappa were concerned, the objects like knives, axes and chisels were seen to have been alloyed with tin more than other objects.[390] Therefore, the fact that luxury objects had a higher tin percentage was peculiar to Lothal.

S. R. Rao also points out that the smiths of Lothal had introduced some new types of tools to the repertoire of the Harappans. These consists of the drill with twisted grooves, the needle with eyelet at the piercing end, the planer-bit and the curved saw.[391] The twisted drill, according to Rao, is the forerunner of the modern drill. It was useful in drilling holes in wood as well as metal sheets. The needle with an eyelet at the piercing end was similarly another improvement. The circular saw could be used for cutting grooves in cylindrical objects.[392] Among utensils, the copper jar with a convex or concave-convex profile is a very common type at the site.[393]

S. R. Rao reports the recovery of an unique copper objects from Lothal viz., a sleeved copper axe which, according to him, vaguely resembles the anthropomorphic figure of copper from Bisauli in Uttar Pradesh. He also points out that, so far as manufacturing techniques go, both these specimens were first cast and then hammered.[394] But he concedes that in composition they vary considerably and concludes that although this axe from Lothal is non-Harappan in type and technology, yet it is doubtful if it came from the copper hoards of the Ganga Valley.[395] D. P. Agrawal, however, points out that a typical anthropomorph should have a nail-head and sharpened fore-arms. He hesitates to call the Lothal specimen an anthropomorph.[396]

The artistry of the copper-smiths of Lothal is examplified by the copper and bronze figurines of dog and hare and the copper hair-pin with bird-head.[397] Rao points out that the smiths knew the techniques of *cire-perdue* casting. The miniature figure of the dog bear testimony to this.[398]

Lothal has also yielded the remains of what may have been a bead factory in the lower town. Hundreds of carnelian beads in different stages of manufacture were found here. A circular Kiln uneartherd near by, may have been used for heating the raw material and finished product. Amidst these, micro-beads of gold have been found.[399]

The discovery of two workshops of copper-smiths and

their equipments, such as a brick-lined furnace, stone anvil, terracotta crucibles and copper implements at these workshops.[400] indicates that Lothal had a local metal industry. Going into the details we may refer to S. R. Rao mentioning a small bowl-shaped crucible of sand stone which must have been used for melting metals. Two rectangular slabs of sandstone with groove-like depressions were used for casting small objects like pins and needles.[401] Five rectangular brick pavements could have been copper smiths' workshop. The presence of a pot furnace, near each sink, containing ash and bits of muffles strengthen this speculation.[402] Another area has been pointed out by the excavator as having been used for resmelting ingots consisting of a circular mudbrick Kiln near the above workshop. An earthenware bowl and large sheets of copper in the form of flat chunks have been recovered from it.[403] We have been seen above that the commonest technique employed by Harappans for shaping objects was that of hammering sheet metal. Hence the presence of these flattish chunks have obvious relevance. A rectangular furnace of burnt-bricks was also located at a workshop in the Lower Town at Lothal. The contents of the Kiln were ash and other associated finds mentioned above.[404]

Coming to the question of the probable source of the copper for the Harappans at Lothal, S. R. Rao digresses from the theory of D. P. Agrawal and other scholars who have accepted that the Harappans obtained a large supply of copper from the Khetri mines in Rajasthan. S. R. Rao points out that the presence of arsenic in the Indus Valley copper objects and ingots suggests that the ore came from Rajasthan or Afghanisthan. However, neither in the bun-shaped copper ingot nor in the thousand other copper objects found at Lothal is arsenic found in any appreciable quantity.[405] He suggests that Lothal got copper from a source which did not contain arsenic as an impurity. He points out that Sumerian cities also used copper which was free from arsenic.[406] According to him the Harappan metropolis at

Lothal served as a port which carried out a flourishing maritime trade with the Sumerian cities and he suggests that Oman in South Arabia was perhaps the common source of copper for both the Sumerian cities and Lothal. He also points out that there is a close similarity in the size, weight and composition of the copper ingots from Susa and Lothal, both which had established trade contacts.[407] Lately, S. R. Rao has put forward the argument that Sumer and Lothal must have obtained their copper supply from a common source.[408] On the other hand, the Allchins points out, the great brick tank, interpreted by Rao as a dock at Lothal cannot yet be certainly identified.[409] C. L. Possehl has also doubted the maritime trade relations between Lothal and Persian Gulf countries.[410]

But even if we accept that Lothal carried out a flourishing trade with the Sumerian cities like Ur., Kish, Susa, Lagash and Tell Asmar,[410] the matter is not resolved. The West Asiatic Cunei form records mention that copper besides other articles was obtained from Meluhha which is generally identified with the Indus region. M. Wheeler puts it '....... Documents show that in the twentieth century B. C. Seafarers were bringing to Ur gold, silver, much copper, lumps of lapis Lazuli, stone beads, ivory combs and ornaments and inlays, eye-paint, wood and perhaps pearls'.[411] A source outside South Asia cannot be ascertained with the meagre evidence of the absence of arsenic traces. D. P. Agrawal points out that Rao has based his conclusion on superficial similarities between the Lothal ingot and those from Susa. S. R. Rao's claim is also based on the absence of arsenic in the Lothal ingot. To this D. P. Agrawal points out that there are a large number of Harappan artifacts where no arsenic is reported and that 'the absence of arsenic is not distinctive at all'.[412] Lastly we may just add that B. B. Lal also suggested that the raw materials used by Lothal smiths for extracting ore was probably different from those used by smiths at Harappa and Mohenjo-daro but Lal is careful in not drawing

conclusions from the meagre data.[413] The recent findings of Cleuziou and Tosi (vide p. 565 of this book) concerning Harappan presence at Oman and Bahrain reopens this issue with full force.

The Harappans at Lothal were also using gold in their ornaments. Literally thousands of tiny beads of gold were used for making a necklace.[414] The important Harappan site in Gujarat, Surkotada, in district Kutch, has yielded a few objects of copper only, comprising copper rings, bangles and a spear-head. The smaller site of Rangpur in district Surendranagar,Gujarat, has yielded seven copper objects in period IIA and one in period IIB, including two flat copper celts with a sharp round cutting edge and almost a flat butt. knives ; copper pins and needles.[415] Among the ornaments were recovered hollow bangles, two finger rings and an amulet.[416] A few ornamental objects of gold were also recovered from Rangpur, viz., a fragment of a necklace with four circlets which might have been used as a spacer bend from period IIA and a steatite ornament of floral design dusted with gold from the last phase of the mature Harappan level.[417]

B. B. Lal reports that the study of the metal objects from Rangpur reveal that the techniques of casting and forging were well understood by the craftsmen of the time. The use of tin as a deoxidising agent and for hardening copper was also known.[418] Most of the objects are made of copper with nickel, and iron as minor impurities and tin in small proportions. However, B. B. Lal points out that the proportion of tin is fairly high in the copper celt (No.663), hollow bangle (No.169), knife (No.141), and knife (No.526) from the Harappan level, period IIA, having a percentage of 6.94, 6.78, 5.28 and 4.00 respectively. This indicates that a low tin bronze was used in the making of these objects.[419] Thus the Harappan copper smiths at Rangpur understood well the use of tin for making bronze. Arsenic is reported to be present in two specimens only.

The evidences of metal artifacts from other Harapan sites more or less represent a similar pattern in manufacture, nature of objects and their shapes. Surkotada in Kutch has yielded about 129 objects recently which comprise mainly blades of simple variety as well as crescent-shaped arrowhead, knife with thin leaf-shaped, blade, drill, spear head with a tang, socketed axe, lid with raised edge, fishhook, antimony rod, hook, chain and among ornaments-metal beads, bangles, ring, and ear-ornament. Moreover the[420] fragments of a crucible have also been recovered. All items have a high tin content and traces of arsenic and lead. Finds from most sites have not been properly analysed. They include Suktagendor where Aurel Stein had detected metal artifacts like barbed object, bead, knife, celt, needle as early as 1931.[421] The report of J. F. Jarrige on Nausharo mentions recovery of arrowhead, blade, chisel, razor, pin, ball, seal, ring, button and even a copper lump.[422] Fairservis reports the finding of metal axe, spearhead, bead, pin and hook from Allahadino.[423] The recently discovered site of Dholavira in Gujatat has yielded copper seal, knife, chisel, bead, bangle ornaments and other unidentifiable pieces.[424]

The survey of findings at the smaller sites do suggest distinctions between life at the metropolises and their bucolic satellites. Only more extensive excavations and analysis of data can prove the point, but from the material at hand one can observe that the metal technology was more at the service of the busy, populous centres than the rural settlements. The technological finesse was not a standardised item. The availability of metal, metal smiths, the requirements and affordability of populations and settlements were criteria which clinched the issue. So parallel to classical developments noted at metropolises were the modest representations at the smaller settlements. The destination of the supply of ores as well as finished items, if any, were the richer metropolises with their richer markets. Market economy was a likely operative in this nexus along with the system of feudal tariff as suggested by Shereen Ratnagar.[425]

The above survey reveals that the metal industry had become one of the most important ones which catered to the needs of the sophisticated Harappan society. The copper smiths of the Harappan society served a variety of clienteles, from the farmer and craftsmen to the warrior, hunter and the rich men and women who fancied the metal ornaments. Besides, other precious metals like the gold and silver were also being handled by the smiths for making jewellery. The composition and art of making these various objects indicate that there may have been specialisations within the metal industry. As the Allchins point out there is little doubt that such special objects like the cast bronze figures of the dancing girl or the little model carts, or the cast dog, hare or elephant from the Harappan cities were the products of the specialists' workshops which were present atleast in some central cities.[426]

However, most of the utilitarian products as well as weapons produced by the Mature Harappan craftsmen exhibit a degree of uniformity similar to that found in town-planning and structure plans. From the outset of the Mature Indus period, there is a much greater quantity of evidence for copper and bronze technology than ever noted in the Pre-Harappan context. However, the background for such a development was set in this very subcontinent of ours, especially as noted for the time being at Ghar-i-Mar, Mehrgarh, Nal, Kalibangan and Mundigak. What we need is further and more elaborate excavations in the north-west of the subcontinent, comprising Baluchistan, Afghanistan, Sind, Punjab, (western and eastern), and Gujarat and the regions east of Sutlej in Rajasthan and Haryana in order to trace the development of metallurgy to its roots in this subcontinent. The evidences available to us at present do not negate the above possibility, infact new evidences consolidate our thesis. That the principal source of copper ore was in the Khetri Ganeshwar area of Rajasthan.[427]

Let us make a few observations here. The north east

Rajasthan was, by all analysis, contributing a large supply a copper are and finished objects since the Pre Harappan times to the nascent settlements that later attained heights of arbanity under an identifiable imperialistic canopy, a development that assumed the proportions of a homogeneous cultural enclave. The status of the outside supplier society has to be determined here.The available evidences for the most likely candidate among suppliers from Rajasthan, the Ganeshwar-Jodhpura culture, never attained Harappan heights, far from it. We shall take up the issue later. Here, we can also identify the regions of Afghanisthan and Baluchistan as having been suppliers of copper to the Harappan society. The evidences of old workings at Saindak region in Afghanisthan date back to the fourth millennium B.C.[428] The region of Las Bela in the Khurkhera plain of Baluchistan was another likely source of copper.

Old accounts reported the plentiful occurrence of copper in Las Bela.[429] We have already referred to Pre-Harappan status of metal use at the site of Balakot in Las Bela. At the Harappan level the Balakotian examples comprise 12 scoriae and prills of copper, 15 copper fragments of pins, beads, rings and small flat plates. At least three fragments of ceramic crucibles with adhering patches of copper dross are present. Metallographic analyses show that the smiths were employing a range of techniques like hardening, annealing, smelting, sinking and raising running on and even casting.[430] G. F. Dales has raised the pertinent questions, whether the industry was localized or wheter the artifacts were imported from larger Harappan sites. The small number of metals recovered do raise doubts. However, we must note that nowhere did the supplier settlement show signs of using metals on a scale comparable to that at the receiving sites. There are the above evidences to prove at least secondary smelting or cycling of metal at the site. Only further study can resolve the question satisfactorily including a fuller study of the little reported complex of Edith Shahr.

The Harappans practised delibrate alloying of copper with tin, lead, arsenic and also nickel. D. P. Agrawal points out that bronze was relatively more abundant in the upper levels at Mohenjo-daro than the lower levels i.e., 23% of tools were of bronze in the upper levels as against 6% of tools of bronze in the lower levels.[431] D. P. Agrawal mentions that out of the 177 metal artifacts from Mohenjo-daro and Harappa, studied by him, 70% indicated no alloying and 30% show tin-alloying. However, only 14% of the tools were in the range of 8 to 12% of tin-content.[432] Out of twenty artifacts from Harappa analysed by S. Prakash and Rawat, nine indicate tin-alloying in the range of 3.6 to 10.45 percent.[433] He also points out that tin varies from 2.6 to 11.07% in seven tools out of thirteen analysed from Rangpur.[434] For optimum ductility and hardness, 8-12% of the tin should be mixed in copper. But among the Harappan metal artifacts one finds only a small percentage of tools in this range which may suggest that the Harappans either did not know the optimum range or could not control correct mixing.[435] However, they were very aware of the advantages gained by tin alloying as is evident in their restricted use of it to artifacts which were used against hard surfaces. e.g., knives, axes, and chisels.[436] However, the fact that 70% of the tools were of copper only indicates that tin was scarce.[437] It may have been more so further away from the Sind and the Punjab regions, for the alluvial source of tin in the form of cassiterite could not have been sufficient and the main supplies may have come from the Persian sources already mentioned. If so, then it is likely that the smiths in the metropolises of Harappa and Mohenjo-daro used up the majority of the supply and those in the far-off towns like Lothal and Kalibagan may not have had a good supply. Hence, the practical absence of tin alloying in the Kalibagan assemblages and restricted use of tin-alloy in the smaller items from Lothal.

Lead (1 to 2% of it) was used mainly to increase the

fusibility of copper while casting. Cerrusite, a carbonate ore of lead, has been reported from the Harappan sites, Galena ore has been recorded from Mohenjo-daro.[438] However, only 6% of the tools from Harappa and Mohenjo-daro indicate lead alloying (1.32% of lead content.[439] Lead was also most probably used for extracting silver. This practice may have been in vogue since the pre-Harappan days as the evidence from Nal shows.

Arsenic was used to increase the hardness of the metal artifacts. Even 1% of arsenic increased the hardness of the copper. However, only about 8% tools from Mohenjo-daro indicate arsenic alloying in the range of 1 to 7%. D.P. Agrawal suggests that the small percentage of arsenic alloying may be due to their ignorance about its effect on hardness.[440] He points out that the Harappans probably used it only as a deoxidiser for copper castings.[441]

Nickel is common in the copper objects as an impurity. However, its deliberate addition is attested to only from Rangpur and Mohenjo-daro. At the latter site only seven tools have it in the range of 1 to 9%.[442]

The Harappan had probably mastered the technique of smelting sulphide and oxide ores from the early phase of the Mature Harappan culture.[443] They employed various methods of fabrication. They chiselled out some objects from thin sheets of copper, for example, razors, arrow-heads, knives, spear-heads, saws, so on. The metallographic analyses of Harappan objects indicate the employment of cold hammering to increase the hardness of an artifact. They also carried out annealing processes to make the metal malleable and ductile after cold hammering.[444] The vessels and utensils the Harappans made required the processes of 'sinking' and 'raising' to beat the metal discs and shape them into the desired forms. We have already gone into the modes of casting practised by the Harappans. A large number of flat axes and other flat objects from the Harappan sites indicate the use of open flat moulds.[445] We have already gone into

Sana Ullah's views as to the simple casting as well as rivetting in case of some copper-bronze vessels from Mohenjo-daro.[446] D.P. Agrawal points out that it is because of the case of open mould casting that we have mostly flat axes and very simple tools in the Harappan assemblages.[447] However, the use of the *cire perdue* method of casting is also evident in a few specimens of metal sculpture. The technique of soldering, though not evident for copper objects, was widely used in case of gold and silver ornaments etc. in the Harappan times.[448]

Thus we find that the Harappans were handling a quite developed metal industry in which there were perhaps classified sections, viz., copper-works, and gold-silver works. The methods of metallurgy were most often than not common to both except for the mode of ore-extraction, which we have already studied in some details. Moreover, they also handled a number of metals like lead, nickel, tin and arsenic for alloying. Thus the Harappans were already witnessing the emergence for polymetallism. The Harappans had a regular supply of copper. We have noted the likely sources for this as well as other metals used by them. What is evident is that here we have a full-fledged metal industry with divisions and sub-divisions in it, the workers of utility utensils, implements and weapons forming major sections ; the workers of finer objects like various ornamental articles and sculptures as well as other miscellaneous objects forming a separate division. This industry catered to the needs of the stratified Harappan society. The economy of the Harappan culture was definitely intimately bound up with the development of this industry. We may mention here that the metal utensils of the Mature Harappans reflect the styles of their ceramic vessels, while the metal weapons and some tools bear similarity with the stone implements their predecessors used. Therefore, the prior development of the stone and ceramic industries in the Pre-Harappan context may have had a great role in the birth of the metal industry

as far as typology was concerned. (The use of firing techniques in the ceramic industries and its probable role in the birth of metallurgy has already been discussed at length). The uniformity of the basic tool types produced by the Harappan craftsmen may reflect the degree of centralisation achieved by the Harappans in the field of production or it may more probably indicate the efficiency of distribution throughout the Harappan realm. There is no doubt about the wide net-work of communications having existed not only throughout the Harappan cultural zone, but also outside for they had a far-flung trade-network throughout India, Pakistan, Baluchistan, Afghanistan, and further west. Indeed, the Harappans were traversing long distance routes both on the sea and over land in order to reach out to the people, in different socio-economic backgrounds, in different geographical settings, for carrying out trade and commerce. There is no doubt that in the process, a lot of cultural contact had been established with these people in the outlying regions, which might have given a lot of colour and elements into the Harappan Culture. It may have been that the Harappan metal industry received great impetus from these outer West Asian contacts. However, we cannot ignore the process of development that had already taken place in this very sub-continent from the distant Pre-Harappan days onwards. These features of a busy commerce in various goods, an agricultural surplus (as we have already seen), and a growing industrial atmosphere brought the Harappans on the thresholds of urbanisation.

V. Gordon Childe remarked that the use of metal tools does not depend upon simply technical knowledge. An effective social surplus is required before a community can use metal tools.[449] As the Allchins point out the Mature Indus Civilization was the result of the concurrence of three major factors.[450] The first, perhaps the most important, was the existence of incipient urban, semi-urban, and non-urban communities in and around the regions where the Mature

Harappan Culture flourished, with centres of local trade and craft specialisation already in existence. A whole variety of economic as well as non-productive activities and widely different life styles were in evidence. In fact our survey of the two basic sectors of food economy and the metal technology do point to the genesis of a social growth already in the regions covering Baluchistan plains, the Indus Valley region, the Gujarat coast and Saurashtra, northern Rajasthan and even Haryana prior to the Harappan experience. By the Harappan times the social fabric had become more complex thus enlarging the scope of any production sector. The Metal works must have catered to a wide selection of people.

The metal-smiths of the Harappan Culture were supplying objects to all the sections of the society. Metals were being used widely for various purposes. A study of the nature of metal tools that have come from the different Harappan sites may throw some interesting light on the rich fabric of the society and the various types of professionals present in that context. We may categorise the metal objects in the following manner : Household objects ; craftsmen's tools ; objects that may have been employed in trade ; weapons for war or protection ; implements used in agriculture ; and certain miscellaneous objects. Besides these there were the luxury items-jewelleries. These might have formed a separate department altogether. The fine, aesthetically super pieces of metal sculptures like the dancing girl and the carts or chariots might have had a religious value also.

The metal utensils like the jars, dishes—often with handled covers, bowls, vases, the handled copper canister from Chanhudaro, hooks, latches, nail, parers, needles, pins etc. might have been used by the people in daily life. Chisels, saws, drills, awls, spatula, gouges, plumb-bobs etc. were the implements used by the craftsmen in different jobs. Weighing scales, pens, beams were used for trading as well as technical purposes. The common presence of fish-hooks at many of the Harappan sites may indicate the proliferate practice of fishing, which might have been an occupation of some

people. Spear-heads, blade axes or adzes, razors, dagger knives and arrow-heads were employed in warfare and defence. However, some of the narrow axes and chisels might have been used in other manners. For example D.P. Agrawal has suggested that some of these could have been employed in agricultural jobs.[451] The sickles, knives and shovels were employed by the farmers. A number of objects mentioned above may have been used in a number of ways — like the razors, axes, chisels, knives, etc.

Lastly, there was the rich and important people in this complex society who possessed the metal jewelleries and copper mirror etc. for personal adornement and toilet purposes. These were probably also necessary items to establish primacy in a stratified society — be it a ruling warrior class or an esteemed priestly class. Thus, the rich fabric of the Harappan society emerges clearly before us from this study. It also becomes extremely clear how far the use of metals had impregnated in the everyday life of the Harappans. The metal industry had indeed formed a very important feature of the urban Harappan culture.

IV
LATE HARAPPAN

The overall degeneration of cities and towns in the Late Harappan phase was associated with the decay of the flourishing trade noted above. The material culture that had flourished during the Mature Harappan period was obviously affected. S.P. Gupta points out that when a civilization of the Harappan type declines due to forces other than political (i.e. flood, dessication, invasion, etc.) a definite cultural process (diffusion etc.) sets in. This leads to new settlement patterns, such as the clustering of villages in newly occupied areas.[452] This was very much evident in the case of the Late Harappans. The Harappans were seen to be moving eastwards from the regions of Sind, Western Punjab and Rajasthan to the eastern Punjab, Harayana and even the upper plains of the Ganga-Yamuna Doab. There were

conscious efforts on the part of the people to readjust their life to the new hydrological and socio-economic conditions.[453] In the circumstances, their main attention would be claimed by the activities of primary production, viz., animal husbandry and agriculture, in the new conditions. The handicrafts would definitely suffer not only because in this new social set-up there would be no adequate social surplus to provide opportunities for the growth of fullfledged craft industries, but also because the previous trade network could not be maintained. The supply of raw materials would become difficult. However, as S.P. Gupta points out. some crafts like the metal-works may persist on a very much reduced scale.[454] The small amount of metal from Rangpur II B-C, Lothal B, Dadheri and Bhagwanpura indicate this. However, we may note that at least at Rangpur and Lothal this is less evident for these sites had a Mature Harappan background. Although the instances of use of copper had reduced quantitatively the technical know-how did not die out as is evident from the metal artifacts recovered at the Late Harappan phase at the site of Daimabad, Maharashtra.

S. R. Rao also points out, as far as the Late Harappan complex in Gujarat is concerned, the technology did not suffer although copper had become scarce. The tool types remained the same.[455] The Lothal B (Late Harappan) levels yielded a total of 102 objects of copper or its alloy. S.R. Rao states that most of them are too fragmentary to be identified as tools or ornaments. However, some new tools were encountered in the Lothal B period, viz., a shaft balance, transverse axe and awl. Flat celts of Harappan type continued to be produced by the Late Harappans at the site. S.R. Rao gives a list of identified objects.[456] The shaft balance containing 0.19% nickel and no tin ; transverse axe with traces of nickel and no tin ; the awl with a round section (not analysed) ; an axe with a short broad blade with 70% copper and no tin ; a lunate shaped blade (not analysed) ; nail with a square section (not analysed) ; hook with a

round section, perhaps a fish hook of which the barb loop and shank are damaged (not analysed) ; a bangle with overlapping ends (not analysed) ; ring with 63.58% copper and traces of iron ; a ring coiled in three spirals made from a flat strap ; and a figurine of a fowl with a prominent crown and a short pointed beak, the last two objects not analysed.[457] From Rangpur, for example, the occurrence of the flat celts, one with straight sides, and two engraved with peacock-designs as the Mohenjo-daro ones, the two fragmentary knives, solid and hollow bangles,[458] with a high tin content (11.07%)[459] in case of the former type of bangle, indicate that the traditions of the earlier Mature Harappan phase continued in some cases. On an average, the tin content in the Rangpur metal artifacts was high, followed by nickel.[460] The site of Rojdi in Saurashtra has yielded chisels, celts, a rod, bangles and a ring at the Late Harappan phase, with a high tin content in one artifact and the percentage of zinc, nickel equalling with tin in others.[461]

The Prabhas Culture evolved in Gujarat around C 1800 B.C. and ended around C 1200 B.C.[462] The culture is named after the type site Prabhas Patan or Somnath, in District Junagadh, and is characterised by its painted pottery treated with a pinkish or orange wash and painted in purple or dark brown.[463] A few copper axes have been recovered at Somnath in the early excavations.[464] Later a few more bits of copper were also found.[465] We may note that excellent copper ore was available plentifully in the adjacent areas now in Amreli district.[466]

An axe from Somnath was subjected to examinations. It was found that the specimen had 81.86% of pure copper, 12.82% of tin and 1.21% of lead. It is clear that there was a deliberate alloying done. The external features show that the axe possesses a smooth surface-finish and is non-magnetic. When cut, the specimen showed characteristic bronze colour.[467] An examination of the microstructure of the body indicated that metal was not subjected to heavy

hot work or cold work. However, the cutting edge of the axe was shaped by repeated cold work and intermittent annealing. The body was also subjected to some heat which gave rise to grain growth. K. T. M. Hegde has pointed out that it also seems that the object was not finally annealed and left in cold worked condition, which imparts a hardness to the copper objects — a necessary quality in a cutting tool.[468] Thus, it appears that the smiths in Gujarat in the second millennium were still quite adept at their job and employed those metallurgical techniques that they deemed best for the occasion.

The Late Harappan sites on the Sutlej, viz., Ropar, Kotla Nihang Khan, Dher Majra, Chandigarh Cemetery, Bhagwanpura,[469] Dadheri, Katpalon, Nagar,[470] and Banawali (Late Harappan Phase)[471] have yielded small amounts of copper objects like rings and pins. bangles, rods etc.[472] At Ropar (IB) particularly, a rich assemblage of copper and bronze objects have been recovered, comprising bronze celts, spear heads, razor blades, bangle, ring and arrow head, which indicate the continuity of the Mature Harappan traditions.[473]

At Mitathal the Harappa Culture (Period IIA) was followed by the Late Harappan (Period IIB), marked by a gradual decline in the material culture.[474] Suraj Bhan also points out that the Mithathal IIB ware has close affinities with the Bara Ware in typology as well as decoration.[475] The occurrence of a copper harpoon is very interesting[476] and may indicate a link with the Ganeshwar Culture in Rajashthan as well as the Copper Hoards in the Ganges Yamuna Doad region. The presence of a chopper-type *paraśu*[477] is also significant as a similar implement occurred at Pre-Harappan Kalibangan[478] as well as at Khurdi or Kurada and Ahar in Rajasthan.[479] other copper objects include a celt and rings.[480] Suraj Bhan points out that the occurrence of copper hoard tools as well as Harappan type celts and rings at Mitathal indicate an association of the Copper Hoards with the Late Harappan at Mitathal IIB.[481]

We may here point out that S.R. Rao had (p. 434 of this book) hinted at a similar association in case of Lothal. These may be significant pointers to cultural links.

The site, Bara, six kilometers to the south-west of Ropar is the type site of the Bara Ware Culture. However, here also in the middle levels Harappan contact is clear. These levels have yielded a meagre supply of bronze objects, viz., a fragmentary bangle, a fish hook and pieces of wire. We may note that terracotta triangular cakes, bull figurines, agate, carnelian and faience beads and some typical Harappan ceremic forms were present here.[482]

The Late Harappan complex in Western Uttar Pradesh also attest the fact that degenerated or devolved Late Harappan culture was flourishing here with the people trying their best to adjust their older cultural traits to new situations.These people had a very limited (almost non-existent in the some cases) copper or copper-bronze repertoire. At Hulas the period I yielded a single bangle of copper.[483] Alamgirpur has yielded pins and a broken blade of bronze or copper from the period I (Harappan levels).[484] Bargaon in district Saharanpur yielded copper rings.[485]

At none of these above Late Harappan sites do we find a rich variety of metal objects. The associated assemblages often comprising beads of semi-precious stones, bangles, triangular cakes and other objects of terracotta and more rarely terracotta toy-cart wheels as well as the ceramics — Harappan as well as the OCP and other wares like the Bara, in some cases reveal that the vestiges of the earlier life remained but these were much devoluted and mixed with newer cultural elements. The days of the Harappan urbanity were indeed at an end. The glory of the Harappan metal industry was fading out. The struggle of adjusting to new settings required a total involvement with more basic activities than such high technological ventures as the metal works and these were becoming very expensive from all points of view.

Daimabad on the bank of the Pravara, has yielded the most remarkable piece of evidence as far as the story of metal industry in the Central Indian and Deccan Chalcolithic context goes. From this site a hoard of four massive copper — bronze pieces of sculptures were recovered. These comprise the figure of an elephant, rhinoceros and buffalo, all standing on cast copper platforms, which in case of the two latter specimens had brackets containing solid copper axles and cast wheels.[486] The fourth object is the most elaborate, consisting of a two-wheeled chariot with a standing human rider, drawn by two yoked oxen attached to the chariot by a long metal pole.[487] We have already noted these objects earlier.

We have also raised earlier the point that these massive pieces of bronze sculptures aroused a lot of controversy regarding the question of their presence at Daimabad. It has been argued by a group of scholars that these specimens could not have belonged to the chalcolithic phase at Daimabad. D. P. Agrawal, R. V. Krishnamurthy and S. Kusumgar have argued that, "We would not be surprised if these images turned out to be of the historical period".[488] This argument is based on the grounds that in general no arsenical alloying has been reported from the chalcolithic cultural assemblages so far, and, moreover, that the chalcolithic cultures in the Deccan are very poor in copper. The Daimabad pieces, on the other hand, contain more than one percent of arsenic and the pieces are massive and completely out of place in the chalcolithic context.[489]

However, excavations at Daimabad show it to be a purely chalcolithic site which was first occupied about C. 2000 B. C. and finally deserted by about C 1000 B. C. M. K. Dhavalikar states categorically that he did not come across any evidence for a later pit during his examination of the spot. He mentions that, on the contrary, the layers at Daimabad were undisturbed by any later activity so that no question of a later addition of these pieces can be envisaged.

The site was never reoccupied after it was abandoned around C 1000 B. C.[490] Hence, there is no questions of a historical phase having existed at Daimabad. Subsequently, S. A. Sali's excavations at Daimabad has brought out into the open a Late Harappan phase at the site, datable between C 1800 B. C. and C 1600 B. C.[491] S. A. Sali,[492] and M. N. Deshpande,[493] who excavated Daimabad earlier, are of the opinion that the said metal sculptures belong to this Late Harappan Phase at Daimabad on circumstantial and stylistic evidence. S. R. Rao states that his examination of the place where the bronzes had been discovered indicates that on the basis of stratigraphic and ceramic evidence the bronzes come from the Late Harappan Strata.[494]

According to M. K. Dhavalikar, the specific features of the modelling of these sculptures also point to a Harappan affinity. Some features of the metal chariot resemble the Harappan metal models of cart, although none of these latter were as elaborately designed as the Daimabad specimen.[495] Some features of the chariot were also likened to the Sumerian Chariots.[496] The Daimabad rhinoceros resembles closely the rhinoceros depicted on some Indus seals. Dhavalikar also mentions a significant fact that the rhinoceros has been portrayed in the Harappan context and has never had a later portrayal in protohistoric or historic Indian art.[497] The Daimabad example, moreover, can be likened to the terracotta specimen from Lothal.[498] S. A. Sali has made a very interesting suggestion to point out a Harappan affinity at the level of symbolism and religious totemisation. He points, out that the rider of the above chariot can be identified with the Pasupati figure in the famous Paśupati seal from Mohenjo-daro. The rider had a head dress which is significantly similar. Moreover, a four hooded cobra head covers his penis. Sali concludes that the human figure represents "....... Pasupati Siva the Lord of Beasts".[499]

Dhavalikar points out that once the Late Harappan origin of the above copper-bronze sculptures is established, the

possibility that they were imported to Deccan from outer Harappan centres becomes highly probable, and it should be noted the bronzes of the Harappan culture show a marked proportion of arsenic in them. The presence of this very arsenic in the Daimabad specimens was putting the question of the origin of these objects into a lot of controversy. But if these objects are taken to have been imports from the Harappan centres, this problem is resolved.

Moreover, the point argued by the scholars, that the Daimabad pieces were too massive to belong to the Deccan chalcolithic assemblage, where copper was rather scarce can also be washed away by the counter argument that the Harappans presumably had a plentiful supply of copper as attested by the artifacts of this context. H. D. Sankalia also concluded that 'the presence of arsenic in the Daimabad bronzes might show that they were manufactured in the Indus Valley proper, and not in the Deccan, and brought here by immigrants'.[500]

It has been put forward by M. K. Dhavalikar that the Daimabad sculptures may have had some religious signficance which accounts for their massiveness and their having been unique at Daimabad. The bronzes must have been very costly, considering the scarcity of copper and the massiveness of the objects as well as the probability that they were brought from afar. The bronzes may have been sculpted on the order of some ruling authority or religious priest with the consent of the whole community who all contributed to the cost of making them.[501]

We would like to point out here, that, if the Ganeshwar culture in the Sikar district, Rajasthan, could have supplied copper ore and finished goods to the Harappans in the Sind and Punjab and Late Harappans in the Haryana, communications were fairly organised for finished copper bronze objects to be passed on to Maharashtra from the Rajasthan and even beyond from the Indus valley itself. However, we may note that unlike some of the remarkable

Harappan bronze specimens made by the cire perdue technique, these Daimabad specimens were solidly cast.[502]

S. A. Sali has also mentioned the occurrence of a copper/ bronze celt and a bead of gold leaf from this level at Daimabad. The bead of gold leaf, a rare metal in the Deccan chalcolithic assemblage may be regarded as a vestige of the past richness of the Late Harappans. A piece of slag indicates metal smelting activities on the site, though no furnace has so far been found in this phase.[503] S. A. Sali has further pointed out that it is very necessary to investigate the possibility that the bronze sculptures mentioned above were manufactured at Daimabad itself.[504] The Malwa cultural occupation which follows at Daimabad has yielded a copper knife blade and a pin that are quite interesting. The former has parallels from the Harappan sites whereas the latter, a spiral headed pin, can be compared with a Harappan specimen from Chanhu-daro.[505]

V

OTHER CHALCOLITHIC CULTURES

Around the middle of the third millennium B. C. some regions of Rajasthan were witnessing the emergence of a non Harappan chalcolithic culture which were often associated with the OCP and possessed a very rich copper repertoire. The sites, Jodhpura, in District Jaipur, on the bank of the Sabi river and Ganeshwar in the Sikar District, have given the name Ganeshwar Jodhpura Culture to the cultural context characterised by the OCP and some typical copper implement types that have been noted at several sites in the Rajasthan.

Jodhpura is located 98 kilometers from Jaipur town. The mound is situated on the right bank of the Sabi river. Here excavations revealed a thick deposit of OCP, a painted red slipped ware with profuse incised designs on the exterior. This layar is followed by that characterised by the Black and Red Ware. The upper levels of the OCP produced a radio

carbon date between C 2500 B. C. and C 2200 B.C. R. C. Agrawala points out that the beginning of the OCP at Jodhpura may therefore be pushed back to about 2700 to 2800 B. C.[506] He also remarks that in view of these dates it is quite right to call it the Jodhpura culture of the Pre Harappan period as D. P. Agrawal does.[507]

The ancient site near Ganeshwar is ideally situated on the source of one of the streams of the river Kantli which is further fed by other streams from Kanwat-thei-khandela. all located in the copper zone of the Sekhawati region.[508] OCP sherds littered the small mounds outside the Ganeshwar village.[509] We may note here that the distance between Kalibangan and Ganeshwar is about 250 Kms.[510] We may also note that the pottery of Ganeshwar bore resemblance to that from Jodhpura.[511] Moreover, further exploration revealed dozens of OCP sites along various nullahs and streamlets of the Kanwat and the Khandela, originating from Ganeshwar and discharging into the main river Kantli. The pottery occurs throughout the Sikar district.[512] The Dariba copper mines have also yielded Ganeshwar pottery.[513]

Explorations and excavations at Ganeshwar and its vicinity yielded a very rich collection of copper objects, about a thousand in number. These include sixty flat celts. more than four hundred arrow-heads, fifty fish-hooks, dozens of blades, spear-heads, rods, nails, bangles, chisels, etc. R. C. Agrawala points out that these implement — types all belong to the Indus context and not a single specimen is of the Copper-Hoards type of the Ganga-Yamuna doab.[514]

The copper celts from Ganeshwar measures 20 to 25 cm. in length and weigh between 1 and 1.5 kg. Most of them have round indentation marks on the one side of the top.[515] R.C. Agrawala points out that quite significantly the indentation marks on the Ganeshwar celts are near the butt-end whereas those on the chalcolithic celts from Kayatha and Navatoli are on the body of the celt, much below the butt-end. He suggests that this may indicate an earlier date

for the Ganeshwar celts.[516] At Kayatha these celts are assigned a date of 2000-1800 B. C. by radio-carbon determinations.[517] It is also significant that the copper celts do not show any alloying with tin, and that silver, lead, arsenic, tin and nickel are present as impurities. All these flat celts were prepared from moulds by the *cire perdue* technique.[518] The name of a small village *Kulhade-Ke-Johad* (Pond of Axes) near Ganeshwar may bear testimony to the survival of a tradition of axe (Kulhada) manufacture.[519] The indentations on these objects were made with pointed copper drills which have also been found at Ganeshwar.[520]

The arrow heads, cut from thin copper sheets, are like those of the Harappan sites. The Ganeshwar arrow heads, however, are rich and varied in size and shape. Most of them are of the barbed variety. Only a solitary example of the tanged variety come from the surface. The arrow heads were most probably fixed to wooden shafts with a whitish adhesive, which can still be seen on both the sides of arrow-heads along with prominent wood impressions. Arrow-heads from Bagor in the Bhilwara district, Rajasthan, were however provided with two holes each, which allowed them to be fixed to the wooden shaft with the help of a thin wire. Most of these examples have sharp points. But quite a number have curved tips. One copper arrow-head of this kind was excavated from the Harappan levels at Banawali.[521] which was examined by R. C. Agrawala who sees an indication of a possible link between Ganeshwar and the Indus complex at Banawali.[522]

The Ganeshwar variety of arrow-heads was found in negligible numbers at Kalibangan, Lothal, Harappa, Mohenjo-daro and Chanhu-daro.[523] However, the recovery of four hundred arrow-heads from Ganeshwar alone suggests that it was a local product. The rich copper mines nearby were exploited by the people. The analysis of some copper arrow-heads of Ganeshwar, done by Dr. K. K. Tripathi of the Geological Survey of India, Jaipur, shows that 1% arsenic

was present, and silver, lead, tin, nickel, zinc and iron were present as impurities, all occuring in the second place of decimals.[524]

The spear-heads from Ganeshwar are generally very thin. A few thick examples have also been recovered. Comparable objects were found at Mohenjo-daro and Harappa. We may note here that Sana Ullah had earlier suggested that the large thin spear-blades from Mohenjo-daro were not made by the Harappans but were trophies they captured from a people of inferrior culture living in the Sind. Now, with the evidence from Ganeshwar, it may appear that these blades were indeed not made by Harappan smiths but were supplied to them by a contemporary copper-using people in Rajasthan, not as tropics — but probably as items of trade. These blades seem to have been too fragile to be used as weapons. If this was indeed the case, other uses for these blades cannot be ruled out. We have discussed this point earlier.

The Ganeshwar copper fish-hooks are usually not provided with a tang. A similar fish-hook has been recovered from the microlithic site of Buddha Pushkar in the Ajmer District, Rajasthan. These fish-hooks were also found at Harappa and Mohenjo-daro in the early levels. Similar fish-hooks were recovered from Banawali as well.[526] Ganeshwar also yielded a few fragmentary spiral-headed pins which were characteristic of the Harappan Culture.[527] We may note here that, significantly, there is no evidence of tin-bronze at Ganeshwar or the other copper yielding sites in the Rajasthan.

The availability of copper in the Sikar-Jhunjhunu area was the main reason for the development of a copper metallurgy and metal industry in the Sikar District. The metal assemblage at Ganeshwar reveals that the economy of these people was perhaps still at the levels of hunting-gathering, primarily in the period II (4th. millennium B.C.) levels, as the excavators would like to point out. Most of the implements were weapons like arrow-heads, celts, spear-heads and fish-

hooks which reflect this hunting — fishing economy according to them. Moreover, there are no indications of a high cultural life as far as structural and other miscellaneous evidence are concernd. It is more likely that the ready availability of copper sources led on to experimentations locally which gave rise to a local metal industry in these region of northern Rajasthan. We may note that this is the copper belt area of Khetri-Narnaul-Toshan and Sekhawati regions. The similarities in the typology of most of the copper objects from Ganeshwar and the major Harappan sites also give interesting indications of possible links. The period III at Ganeshwar which is contemporary to the Harappan Culture may have witnessed a further development in livelihood. But only more findings can put the matter at rest. What interests us here is the very early beginnings of copper metallurgy in the middle or late fourth millennium. The sheer number of metal artifacts outdistance other contemporary sites in the region. Against this huge metal tradition, the subsistance economy of the site being at a primitive stage raises questions. The higher culture — lesser culture syndrome is noticeable when we surmise that Ganeshwar supplied metals to Kalibangan and other Harappan metropolises. Moreover, about 110 sites or more[528] belonging to this culture context have been discovered in Jaipur, Sikar and Jhunjhunu A total culture enclave specialisting in metal technology can be hypothesised.

We have already seen how the Pre-Harappans at Kalibangan may have obtained the copper ore and even finished objects from the Ganeshwar cultural complex. R. C. Agrawala points out further that copper celts and inverted 'V' shaped arrow heads occur in the Pre-Harappan levels at Kalibangan as at Ganeshwar, a fact which suggests their supply from the Ganeshwar-Khetri region.[529] He also points out that the Kantli river, which seems to have been a major river during the Pre-Harappan period, flowed east of Jhunjhunu town and in the past joined the Drishadvati river somewhere between Nohar and Bhadra from where there is

no difficulty to move on to Kalibangan. This river made possible movement from Ganeshwar to Kalibangan and other Indus sites along the Drishadvati.[530]

According to R. C. Agrawala, the copper objects from Ganeshwar were neither the products of the Harappan refugees nor those of wandering itnerant people. The exploitation of the nearby copper mines and the employment of the techniques of smelting and casting etc. were not jobs done by outsiders.[531] It was the local people who carried out the long and arduous tasks of exploring the local mines, extracting ore and making the finished objects which they required. Such skilled and sophisticated metallurgical operations seem to indicate that after all the economy of these people was quite forward-looking. The people were secure enough about their food requirements to devote so much time and energy to developing their metal industry. This raises a question whether such a state of affairs could have been possible and practicable in a purely hunting economy. Further excavations and investigations are necessary before we can be absolutely certain about their state of economy. The discovery of a rich hoard of 60 copper celts at Ganeshwar also proves beyond doubt that the finished goods were prepared near the site from where they were supplied to different places. R. C. Agrawala, moreover, points out that the existence of a number of hot and cold water springs, around the Ganeshwar, Dariba, Baleshwar, Ahirwala and Chiplata copper mines, all the more suggests the suitability of the area for both habitation and operational purposes, including the extraction of copper ores, smelting and metal casting.[532]

We have already noted how communication may have been possible in the Pre-Harappan and Harappan days through the Kantli river from Ganeshwar to Kalibangan, and other Harappan sites on the Drishadvati river. A net-work of rivers and streams connected this copper-rich region in the Sikar Jaipur and Alwar districts with different regions in

Haryana, Punjab, and Uttar Pradesh. The rich copper mines at Dariba, Ahirwala, Baleshwar, Chiplata, Behar, Mothooka, are all in the vicinity of Ganeshwar.[533] The rivers, Kantli which once seems to have joined the Drishadvati near Nohar-Bhadra ; the Dohan river originating north of the Baleshwar mines flowing through Haryana where a number of protohistoric sites were discoverd on this river by Suraj Bhan ; the Kasaunti also originating near the Dariba-Balehwar copper hills ; and the Sota river originating south-east of the Ahirwala-Dariba mines, all provided communication for the ancient copper tools prepared in the Sikar region to pass on to different regions in Haryana, Punjab and Uttar Pradesh.[534] There is also a land-route from Ganeshwar to Sothi-Bhadra via Neem-Ka-Thana, Khetri, Chirawa and Rajgarh. Moreover, both Hissar and Bhiwani in Haryana were connected with Rajgarh by road.[535] We may again note here that the site of Mitathal near Bhiwani in Haryana had yielded some interesting copper objects viz., a celt, a chopper type parasu, rings and even a harpoon. Two long, heavy copper bar celts bear close resemblance in size and shape to six specimens acquired from a Ganeshwar—related site in the Jaipur district, Nandlalpur.[536] We may note here that Suraj Bhan had also proposed that there was an association between the Copper Hoards and Mitathal (IIB) in the Late Harappan phase based on the copper assemblage at the site. However, after the discovery and connaissance of the Ganeshwar culture there is no doubt that such association also existed between the copper producing centres in Rajasthan and the Pre-Harappan, Harappan and Late Harappan folks in the Haryana, Punjab and North-Western Rajasthan.

Moreover, Ganeshwar falls on the most direct and shortest route connecting Delhi-Indraprastha with the Pre-Harappan site of Kot Diji in the Indus Valley. The road distance between Jaisalmer and Kot Diji is about 300 Kilometers. From Ganeshwar this route goes via Rewari, Narnaul, Neem-Ka-Thana, Parbatsar-Kurade (Khurdi)

Nagpur, Phalodi, Pokran to Jaisalmer. From this last place the route goes via Ghotaru, Mithran, Sangrar, Alor, Sukhar, Rohri, Khairpur to Kot Diji.[537] Harappa is also easy to reach from Kalibangan through the Ghaggar-Hakra and Sutlej Valleys. The Sikar-Jhujhunu copper deposits of the Khetri belt were thus within easy reach for the Indus population, from both Sind (Mohenjo-daro and kot Diji) and Punjab (Harappa).[538]

Some other points also strengthen this theory. For example, John Marshall had stated that some stones in use both at Mohenjo-daro and Harappa were the fine grained yellow Jaisalmer stone, which most certainly came from Rajasthan.[539] This was an indication that trading connections may have been in existence for several types of commodities. Impurity patterns of the Harappan copper objects and various ores shows that there is a close correspondence with the Khetri ores,[540] as we have already noted above. M. S. Vats had also been led to the same conclusion after an analysis of forty-eight Indus-valley copper specimens and the ore samples from Khetri and Alwar. He stated that the Rajasthan mines are not only nearest to Harappa and Mohenjo-daro, of all the copper mines in Bihar, Madhya Pradesh or Afghanistan, but also fulfil the test for the key elements like nickel and arsenic, so that it is very likely that these mines supplied the bulk of the metal for the Indus Valley people.[541] It must be noted here that whatever object or ore that were imported by the Harappans from Rajasthan were of pure copper with minor impurities, and arsenic and nickel content. The copper-bronze with tin or lead alloy was obtained by the Harappans either from other sources or they imported these metals and alloyed them locally to make bronze objects at the Harappan sites R. C. Agrawala points out that the excavations and explorations at Ganeshwar have presented us with a new horizon of Pre-Harappan copper technology which can be dated to the period C 2800 - 2200 B. C. This industry in Rajasthan is associated with the OCP in the region and the total cultural context is designated the

'Ganeshwar-Jodhpura Culture'.[542] Ganeshwar, as R. C. Agrawala and Vijay Kumar points out, was not likely to have been the only site habouring an important copper industry in the Khetri belt. There might have been many more such centres during the Pre-Harappan, Harappan and later periods.[543]

A number of protohistoric sites have been encountered in Rajasthan which have yielded copper objects. It is interesting to note that the people at Ahar in district Udaipur, Rajasthan were, however, exploiting the Umra and Matoon copper mines nearby. The Ahar culture site of Pind Padliya in district Chitor were most probably exploiting the copper deposits of Bhinder and Bhadesara which were richer than the Matoon and Umra mines.[544] Thus the Aharians were most probably not using the copper ores of the Khetri belt.[545]

Other copper-yielding sites in Rajasthan are — Bagor in district Bhilwara Period II (2800-2000 B.C.) yielding three barbed copper arrow heads with holes, a spear, an awl etc; Sabania in district Bikaner, yielding two long copper celts and Indus script ; Pugal in district Bikaner yielding some fragments of copper arrow heads ; the site at Elana, in district Jalore, yielding one flat copper celt ; Budhapuskhar in district Ajmer yielding, as have already noted, an Indus type fish—hook without a tang which bear close resemblance to the Ganeshwar specimens ; Kota Maholi in district Sawai Madhopur, not far from the Chambal river, yielding eight copper celts of a light variety which appear to have been used as agricultural implements like the modern Khurpis.[546]

Kurada (Khurdi) in district Nagaur, Rajasthan, has yielded an unique copper hoard consisting of one hundred and three copper objects comprising seven flat celts, eleven chisels, twenty one curved blades of Ahar Mitathal type, fifty-five rings, four plain copper bowls and five channel spouted bowl and two rings.[547] The channel spouted copper bowls are quite unique in the whole scope of Indian archaeology. These were prepared from thin copper sheet and recall a vessel in metal from Iran.[548] R. C. Agrawala points out that, hence, these vessel from kurada

may have been made for western demand.[549] The curved blades of kurada were also cut from thin copper sheets and were perhaps used as delicate choppers.[550] This were similar to those found by R. C. Agrawala at Ahar and by Suraj Bhan at Mitathal, already mentioned.[551] These can be dated to the second millennium B. C. We may recall that an indeterminate curved blade had also been reported from the pre Harappan levels at Kalibangan, which Lal has designated as a parasu.[552]

We shall come back to Rajasthan subsequently and study the copper works in the Ahar context. But before this we must move on to the Ganges-Yamuna doab and note the copper-Hoard and OCP contexts there, in order to keep the cultural uniformity and continuity intact. We must note here that so far we have not noted a single copper harpoon, anthropomorphic figure or sword typical of the Copper Hoard Culture of the doab in Rajhasthan. Thus, typologically the metal repertoire of the copper hoard folks in the doab is very different from those in Rajasthan. Moreover, chronologically it seems the Copper Hoards of Rajasthan were much earlier than their counter parts in the Ganges-Yamuna doab. However, R. C. Agrawala points out, the copper Hoards in the doab obtained the copper ore and even some finished objects from Rajasthan, especially from the regions around Ganeshwar- Khetri.[553]

COPPER-HOARDS

A variety of copper tools have been discovered in hoards from time to time at a number of sites east of the Rajasthan. These copper Hoards have been located from widely different regions, viz., Shalozan in north-west Pakistan,[554] the Ganges-Yamuna Doab (Bahadarabad, Bisauli etc.), to the eastern regions like Orissa (Bhagrapir) and West Bengal and even from the south, Andhra Pradesh (Kallur).

The copper Hoards are not associated with any artifacts so far and no radio-carbon dates are available for this culture. Hence, a lot of controversy and hypotheses are involved with the question of the authorship and exact contextual position of this culture in the protohistory of the Indian

subcontinent. Heine Geldern proposed that the Copper Hoards represented the remains of the Aryan migration in India. He claimed that the trunnion axe originated in Transcaucasia and reached India via Persia around C 1200-1000 B. C. The axe adze, according to him originated in the Danubian region and reached India via Iran.[555] The antennae swords were influenced by the Kobar examples dated around C 1200-1000 B. C.[556] Stuart Pigott identified the Copper Hoards people as the Harappan refugees.[557] B. B. Lal associated the copper Hoards with the Mundari speaking Australoid tribes of the primaeval Uttar Pradesh (Mundas).[558] Quite significant is the fact that at many sites for example, Bahadarabad, Nasirpur, Bisauli etc. Copper Hoards have been reported as well as the Ochre Coloured pottery. An association between these two traits cannot be overlooked. At Bisauli and Rajpur Parsu, sites in the Doab region, explorations and trial excavations revealed the occurrence of Copper Hoards and deposits of the thick, red, rolled and water logged OCP in close vicinity.[559] The Allchins point out that the Copper Hoards belong to the period of the OCP and may be expected to date from the last half of the third and the whole of the second millennia.[560]

The main implements of the Copper Hoard type are : flat and shouldered celts, barcelts, double axes, antennae swords, harpoons, hooked swords and anthropomorphs.[561] D P. Agrawal remarks that the flat and shouldered celts are reported from all over India and abroad and are too elementary to be treated as diagnostic types.[562] We shall, however, like to point here the findings of these types of celts from West Bengal. Tamajuri in the Midnapore district, West Bengal, has yielded a copper shouldered celt. A similar celt is reported from Chatla in the same district. The third discovery was made at Kulghera (Police Station : Hura) where three shouldered celts and one pick-like object of copper were recovered. Subsequently other sites yielded shouldered celts, viz., Bhaktabandh (Police Station :

Gaṇgajalhati) yielding two specimens, and Aguibani yielding one.[563]

Several specimens of barcelts have come from Hami in the doab region (Bihar) and Gungeria in Madhya Pradesh.[564] The specimens from Hami have been examined by D. P. Agrawal who states that they have generally a flat or slightly concave central side and a convex dorsal side. The edge is produced by bevelling the upper side only. They are quite heavy and long. He is of the opinion that these implements were used for mining of the ores. The usemark observed on them by him indicate that they were used against hard surfaces. He also points out that one of the so-called barcelts from Gungeria was used as a saw with a serrated edge.[565] Parihati (Police Station : Jhargram) in the Bengal-Bihar Border, has yielded a bar celt.[566]

Bhagrapir in Orissa has yielded ten specimens of double axes.[567] They are made by cutting away almost circular pieces from the sides of an oval sheet, thus giving it a distinctive shape. They were quite thin and two of the specimens had both the edges sharpened while a third had only one edge. However. D. P. Agrawal points out that such thin tools with such a big body would buckle the moment they are used as axes.[568] He suggests that they may have been used for different purposes and not as axe. Subsequently five such double axes have been recovered from Parihati (Police Station : Jhargram) in the Kangsavati Valley.

The antennae swords are confined to the Doab Zone (Fatehgarh, Bithur etc.), with the solitary exception of kallur in Andhra Pradesh.[569] The Antennae swords are so called because they display antennae — like bifurcations of the hilt and. The Doab swords are cast with the antennae as one piece and have long blades with a short hilt.[570] At Kallur, Raichur District, the antennae hilted swords have very short antennae compared to the doab specimens.[571] From Mehsana in Gujarat four antennae swords were reported. their antennae are beaten flat and appear more like fans.[572] We

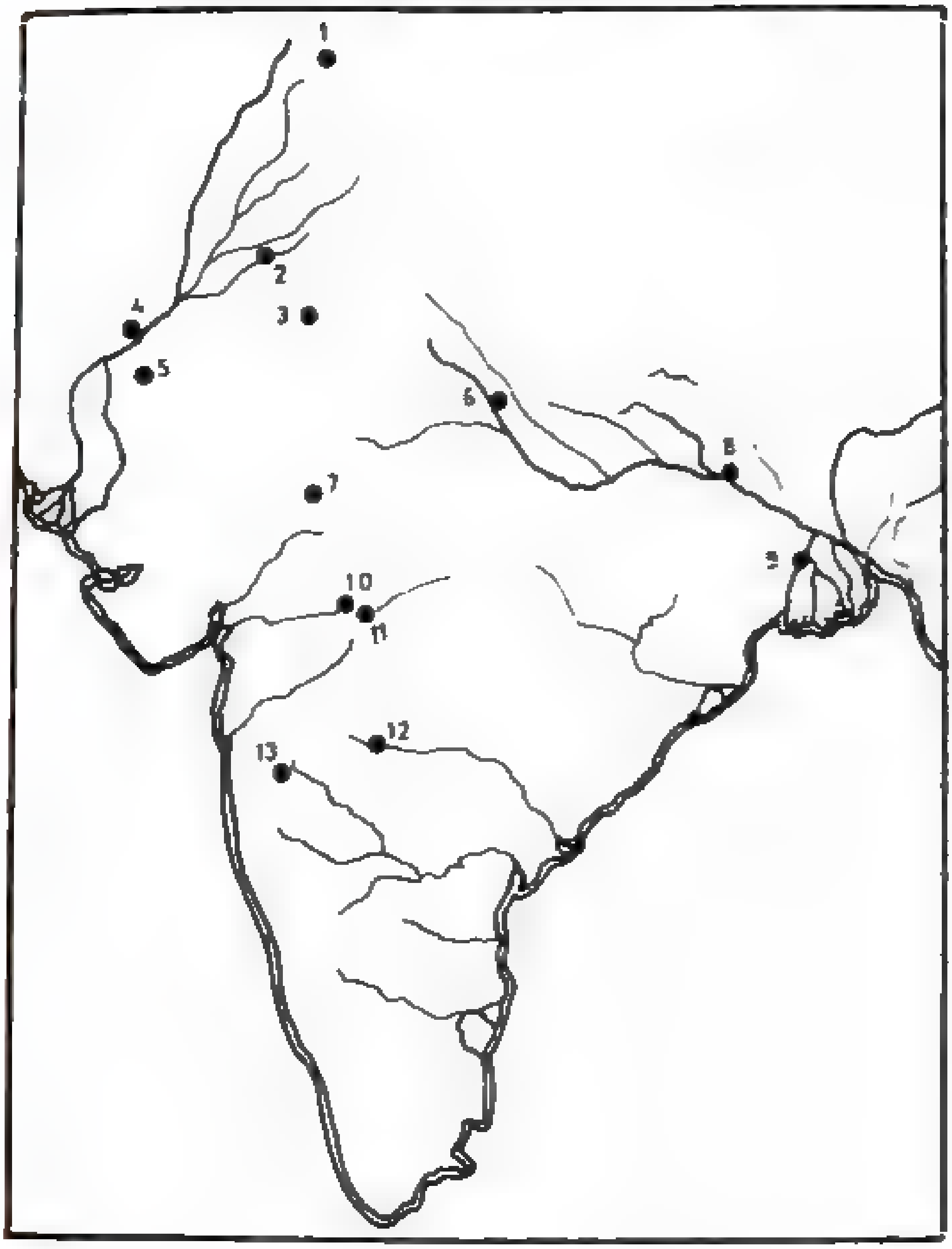
may note here that the Jorwe site in Maharashtra, Chandoli has yielded an antennae hilted dagger which was cast as an ordinary tanged dagger and then the end of the tang was split by a chisel and bent a little to form what looks like antennae.[573] Thus we see that while the antennae swords of the copper-Hoards were cast as one piece, the Chandoli dagger has been cut split and beaten back.[574] Moreover, unlike the diffused ridge of the Chandoli example the Doab specimens have a sharp median ridge. Also the Doab specimens are massive, their length ranging from 42-75 cm. The Chandoli dagger is flimsy by comparison.[575] Therefore, both technologically and functionally the doab specimens cannot be compared with that of Chandoli.

The Copper Hoard harpoons are like mid ribbed swords except that they have barbs pointing backwards and a hole at the end of the barbs. There are two varieties of harpoons, viz., one which is cut from a thick copper sheet, the other, cast in a double mould. The first type looks primitive and crude in comparison to the second. The latter is a superb example of fine workmanship on the part of the smiths of the Copper-Hoard culture. These harpoons could have been used as spear-heads for big game hunting and also for killing large fishes.[576] D. P. Agrawal points out that stratigraphic evidence is required to determine whether the first type of crude harpoon was a prototype of the second fine variety.[577] Harpoons have been recovered from Bisauli, Bithur,[578] Baharia,[579] and Saipai,[580] all in the Ganges-Yamuna doab.

Another distinctive type of copper-Hoard implement is the hooked sword. These swords have a median ridge and a hook chisel led out from the tang. The median ridge is quite sharp.[581] We may note here that at Mohenjo-daro too we have seen the occurrence of four mid ribbed swords with holes on the blade or the tang. However these are without a barb.[582] Such hooked swords have been recovered from Sarthauli, Fatehgarh, Niori, and Bahadarabad.[583]

The most distinctive and enigmatic object of the Copper

DISTRIBUTION OF WHEAT AND BARLEY IN ANCIENT INDIA



KEY-

1 BURZAHOM (WH + BA)
2 HARAPPA (WH + BA)
3 KALIBANGAN (BA)
4 MOHENJO-DARO (WH + BA)
5 CHANHU-DARO (WH + BA)
6 ATRANJIKHERA (WH + BA)
7 KAYATHA (WH)
8 CHIRAND (WH + BA)
9 PANDU RAJAR DHIBI (WH)
10 MAHESHWAR (WH)
11 NAVDATOLI (WH)
12 SONEGAON (WH)
13 INAMGAON (WH)

MAP-XV

WH = WHEAT
BA = BARLEY

Hoard assemblage is the anthropomorph. This consists of a curious shape cut from a plain copper sheet by beating and hammering.[584] The shape resembles the crude silhouette of a human figure in outline. Its three important features are : a hammered and blunted head, externally sharpened and incurved forearms, and plain legs.[585] D. P. Agrawal's trial with an imitation model of an anthropomorph proved that it may have been used as a missile. The object, being made of thin copper sheet flies in the air in a whirling fashion when thrown. The sharp forearms will produce a cut ; the heavy head will stun the prey ; and if the prey is caught in the curved arm the whirling motion will entangle it and bring it down with the missile.[586] How so ever, the above object may have been used by the Copper-Hoards people, there was certainly some religious or totemical significance attached to these objects. Anthropomorphs have been recovered from the Doab sites, Fatehgarh, Bisauli, Sarthauli, Niori and Bahadarabad.[587]

Besides the above mentioned distinctive implements, the Copper-Hoards also yielded rings made of copper wires. Pondi in the Doab region has alone yielded forty-seven rings.[588] Eleven specimens have been recovered from Aguibani (Police Station : Garbeta) in west Bengal and one thick specimen from Parihati.[589] We may note, however, that rings of thick copper wires have come from Harappan sites, noted above. Bargaon District Saharanpur, where Harappan wares found along with an unslipped OCP, has also yielded a similar copper ring.[590] The rings, therefore, appear to be not very distinctive of the Copper-Hoards like the other implements described above.

Lastly, we must mention that a solitary *Parasu* or hatchet has been reported from Sarthauli.[591] We may recall that parasu or hatchets have also been recovered from Pre-Harappa Kalibangan, Late Harappan Mitathal and kurada Copper-Hoard assemblages. A connection between the Copper-Hoards in Rajasthan and those of the Ganges Doab cannot be ruled out.

Thus we find that the Copper-Hoards people in general possessed a large, rich and varied repertoire of copper tools. D. P. Agrawal mentions that about a thousand artifacts have been reported belonging to the Copper Hoards context. Gungeria in the Balaghat District, Madhya Pradesh, south of Jabalpur, has alone yielded 424 copper objects weighing 829 pounds.[592] Here we may note a very interesting fact. About a hundred thin silver plates in the form of a bull's head with down-turned horns were discovered at Gungeria. This occurrence of silver, east of the Indus Valley, in the Pre historic context ot the Copper Hoards is unique.[593] The silver was found to be admixed with 3.7% gold, which indicates the extraction of silver from electrum.[594]

The Copper-Hoards are located in two main regions, the Doab and the south eastern zone. In the Doab region the Copper-Hoards are distributed throughout a zone between 78° and 84° east longitude and in south extending to the north of 24° north latitude.[595] This zone was at that time a thick monsoon forest with plenty of wild food resources and fresh water. In these circumstances, a people settled down towards the end of the third and beginning of the second millennium,[596] who possessed the varied copper implements described above. D.P. Agrawal points out that the rich copper ore deposits of Bihar may have supplied the ore to these people.[597]

The Second zone was to the south and east of the Doab, in the hills and forests of Bihar and Bengal, and even southwards in the wooded regions of Madhya Pradesh. The famous site of Gungeria falls on the extension area of the copper rich Bihar plateau only. The nearness of the Singhbhum copper in Mauladih, Rakha, Masobani sites, must have drawn the attention of the tribal people who settled here.[598] As D. P. Agrawal points out, the rich copper ores of Bihar and the wooded plateau seemed ideal for early metallurgy and even for independent origins of copper metallurgy as B. B. Lal [599] and S .P. Gupta[600] would like to

stress. The Copper Hoard implements revealed that the smiths who created them used closed moulds for casting and employed cold work and annealing.[601] About alloying, Vincent Smith had mentioned a few examples of high grade bronze from the British Museum.[602] However, subsequent analyses did not reveal any tin alloying and B. B. Lal emphasised that the Copper Hoards were not alloyed with tin.[603] However, later analyses by D. P. Agrawal show that 46% of artifacts were alloyed with arsenic (up to 7%).[604]

D. P. Agrawal suggests that the origin of copper metallurgy in this particular context, east of the Indus valley, took place in the Bihar Plateau Zone. He puts forward that the tribal people inhabiting this region may have been curious about the colourful copper ores abounding in the region. Initial curiosity may have been followed by accidental discovery and further experimentations with the metal. He points out that the region also possessed a rich source of fuel in woods. Members of tribal groups may have become smiths who probably became itinerant folks spreading their techniques and tools over a wide region, including the Doab.[605] D. P. Agrawal suggests that these folks were probably responsible for forging the distinctive tools types, suitable for the habitat of the Doab Zone.[606] About this last factor, D. P. Agrawal is of the opinion that the harpoons swords and anthropmorphs, distinctive of the Copper Hoards of the Doab region especially reflect that the people associated with this context in the Doab were in the hunting stage of economy. He suggests that these people were using specialised hunting tools and not a single pot or pan of metal were available which indicate their uncivilised and seminomadic status.[607] H. D. Sankalia, however, is of the opinion that such highly advanced (comparatively) weapons as the antennae swords and the anthropomorphs could not have been used by simple hunting folks just for big game hunting.[608] Moreover, the second type of harpoon, a superb example of craftsmanship employing the use of double mould

and close casting of pure copper, were beyond the reach of such uncivilised folks [609] as D. P. Agrawal thought them to be. Even if these objects were made by itinerant smiths from outer regions, for example, the development of the metallurgy in the outlying Bihar plateau was sure to have been associated at least with some elements of cultural development in this region, which were much more advanced at least from the crude, nomadic hunting stage. Elements of this cultural development must have reached the Doab region along with the itinerant smiths and their metal tools. H. D. Sankalia points out that "in size (and weight), shape and technique the antennae swords, harpoons and anthropomorphs, are much finer and better than those seen in the otherwise advanced Indus Civilization".[610]

He goes on to state that on these grounds only, one should hesitate before crediting these objects to nomads, hunters and itinerant smiths. "The objects might have been made by such roaming smiths, but they were made for a society who needed or had developed the art for making such well developed weapons, by using local resources",[611] as we have already pointed out. According to Sankalia, who clearly associates the copper Hoards with the OCP,[612] the people of this culture were not nomads but lived in simple mud (as well as brick) walled houses and had an assemblage of pots and pans in ceramics, as indicated by the excavations at Saipai and Atranjikhera.[613]

However, we must note that the Copper Hoards of the eastern zone are simpler basic types compared to those of the Doab region, consisting of the flat celts etc., except the bar celt, As D. P. Agrawal pointed cut, keeping in view the abundant resources in copper in Bihar Plateau and the simplicity of the tool types, one may assume rightly that the Copper Hoards of the eastern zone preceded that of the Doab Zone. Thus, we may conjecture the situation thus :- a tribal people in the Bihar plateau, living a simple life, but not uncivilised by any measure, had tread upon the secrets of

metallurgy, perhaps quite by accident. Repeated experiments compounded by trials and errors led them to the development of the craft of metallurgy in which they quickly attained great skill. Some of these folks adopted metallurgy as fullfledged occupations. They become itinerant smiths travelling far and wide throughout the semi tropical forests in the eastern India spreading to the ecologically almost similar Doab region to their west and came upon a group of people who were already living in settlements and possessed a ceramic repertoire. If the archaeological evidences at Atranjikhera, Lal Qila and Saipai are taken into consideration, these people were also engaged in rudimentary farming and animal husbandry (cattle). Now, the itinerant copper smith from Bihar plateau had the job of catering to the needs of this people. The specialised and distinctive Copper Hoards implements were developed.

At the end of this discussion we may once more remark on the wide geographical distribution of the Copper Hoards and the possibilities of zonings and the theories linking cultural traditions. Basically from the point of view of topography, tool typology and communication feasibility, we can discern at least three distinct zones : one, covering Haryana and Rajasthan which may have overspread into western Utter Pradesh ; the second, extending from the upper Ganga Valley to the middle Ganga Valley upto W. Bengal and Orissa ; the third, covering portion of central India, Karnataka, Tamil Nadu and Andhra. D. K. Chakraborty and N. Lahiri have recently argued that the "nothern Rajasthan southern Haryana and the Upper Gangetic Valley specimens belong to a tradition which may be associated with the Late Harappan context in the second millennium B. C. and can be traced, outside their core area, over a wide geographical area involving Gujarat, the Deccan and Southern most reaches of Tamilnadu."[614] Such conclusions run the risk of oversimplification of issues. One has to be clear about the existence of distinctive metal traditions as

well as broader cultural traditions which were not Harappan although having established interactions with the latter culture.

EVIDENCE FROM SOME OF THE OCP SITES

It is logical to pass on to the few excavated sites of the OCP culture in the Doab region. We have already noted the occurrence of the harpoon at Saipai in District Etawah, Uttar Pradesh. Besides this a hooked spear head and some other copper objects were recovered from the site. Most interesting is the fact that the trench that yielded the harpoon was also found to be littered with a red ware or the OCP as B. B. Lal points out.[615]

At Nasirpur, celts, a harpoon, a hooked spear head were recovered. Recent examinations of the locality showed that there was no habitational layer as such. However, the soil contained sherds that on the basis of their colour and texture, may be regarded as belonging to the family of the OCP.[616]

At Bahadarabad and Baharia also we have already noted the occurrences of both OCP and Copper-Hoard artifacts. We have also seen that at Bargaon only the copper ring which may be a distinctive artifact of the copper Hoards, has been recovered.

But most interesting are the evidences from Lal Qila in the Bubandshahr District, where the OCP cultural level has yielded remains of habitational structures.[617] Clay-plastered floors reinforced with rammed pot sherds and series of post-holes, a mudplatforms of rammed earth, the use of mud-clods and brick-bats, burnt bricks and mud-bricks comprise the habitational features. Besides these, reed and bamboo-marked burnt plaster, mud clods and burnt patches indicate the use of thatched roofs and walls of wattle and daub.[618] The Lal Qila pottery is a red ware varying in shades from Ochrous to brownish which belongs to the general family of the OCP.[619] From this site has come fine copper objects, viz., a flat piece of pendant or bead, a piece of an arrowhead,

a celt fragment and an indeterminate copper object [620] None of these objects were distinctive of the Copper Hoards repertoire but this does not preclude the possibility of a link between the OCP culture and the Copper Hoards which is attested elsewhere. It should be noted, however, that some of the OCP sites like Atranjikhera, in the Etah District and Hastinapur in District Meerut, did not yield any copper artifacts in the OCP cultural level. The thermoluminiscence dates from Nasirpur, Jhinhana, Lal Qila and Atranjikhera give a time-bracket of C 2600 - 1100 B.C. for the OCP in the Doab region.[621]

The above survey of the Copper Hoards and OCP metal assemblages and related questions reveals that two distinct batches of OCP and Copper Hoard cultures had sprouted up in the India subcontinent, one sprang up in the Rajasthan quite early in the third millennium B.C., the other arose in the Ganges-Yamuna Doab and Bihar Plateau-Bengal region spreading south in Madhya Pradesh and straying into the Andhra Pradesh, at least as far as the Kallur evidence indicates. This second batch of the OCP as well as Copper Hoards culture belong to a later date, towards the end of the third to the end of the second millennium B. C. The metal industry of both these contexts of OCP-Copper Hoards was rich, variegated and display a great deal of efficient workmanship. The Ganeshwar Culture may even have supplied ready-made copper objects as well as ores to the pre-Harappans, Harappans and Late Harappans in the Sind. Punjab, Gujarat, Rajasthan and Haryana. Thus the tool typology of the Harappans and those of the copper yielding sites of Rajasthan often have similarities. On the other hand. the copper Hoards of the Doab region and the Bihar-Bengal Zone were extremely distinct as far as tool typology is concerned. In both these contexts we note deliberate alloying with arsenic. As to the other methods of metallurgy. we note close-casting and double-mould casting in case of the Doab Copper-Hoard artifacts and close-casting as well as the cire-perdue method in case of the Ganeshwar copper artifacts.

It appears that the copper smiths of both Rajasthan (OCP) and the Doab-Bihar plateau zones were employing quite advanced metallurgical techniques. Nevertheless, one fact strikes us very much that in spite of the developed metallurgy, neither the Ganeshwar Culture nor the Copper Hoards and the OCP folks of the Ganges-Yamuna-Bihar plateau zone were anywhere near the cultural levels reached by the Harappans. Evidently the former people had not yet entered the thresholds of a full-fledged agricultural economy that might produce a surplus. The thickly wooded Doab region and the Bihar plateau in fact seriously limited agricultural activities in the chalcolithic days. The evidences for agriculture from Atranjikhera, although revealing the beginnings of the cultivations of barley, gram and Khesari, would not account for a surplus and intensive agriculture as R. C. Gaur, the excavator, has also pointed out. Although the Banasians or Aharians in the Rajasthan were engaged in agricultural activities but there also we do not have any evidence for large-scale production. They were primarily cultivating only rice. R. C. Agrawala, on the other hand, points out that the Ganeshwar Culture folks may have been primarily a hunting-fishing people as far as their implements indicate.[622] However, we have already discussed above that this could not have been a fact. The metallurgists in Rajasthan and the Doab-Bihar Plateau region must have entered the thresholds of a farming economy. However, an extensive surplus-agriculture was far beyond their reach and this was the reason why, in spite of possessing a rich knowledge and practice of metallurgy, these people, either in Rajasthan or the Doab-Bihar Plateau region, could not be anywhere near an urban development.

AHAR OR BANAS CULTURES :

Now we must turn our attention to the Banas or Ahar culture that was emerging in the Banas river valley in the South-eastern Rajasthan, around the end of the third and beginning of the second millennium B. C.[623]

Ahar in Udaipur, the type-site of the culture, as well as all the other sites of the Banas/Ahar culture were situated in the midst of extensive chalcopyrite copper ore deposits in the Aravalli region. K. T. M. Hegde reports that spectroscopic analysis of the selected artifacts from Ahar period I and copper ore obtained from the ancient mine of Khetri to correlate the two from the impurity patterns indicate that they are almost similar. It is possible that the copper metal of the Ahar artifacts was probably smelted from the chalcopyrite of the Aravalli region.[624] R. C. Agrawala and Vijay Kumar suggest that the copper mines of Matoon and Umara, hardly twelve Kilometers from Ahar, might have been tapped by the Aharians.[625]

The excavations carried out at Ahar by H. D. Sankalia, S. B. Deo and Z. D. Ansari, revealed the occurrence of four socket-less flat copper axes, a small thin copper metal sheet and a few fragments of copper rings[626] and two bangles one each from phase Ia and Ib.[627] Earlier excavations by R. C. Agrawala at the site brought to light a thin knife blade in the lowest levels, dated to about C 2100 B.C. There were also two copper choppers of the Mitathal and Khurdi type .[628]

The four celts were found together, all coming from phase Ib. All of these are more or less of similar type, roughly rectangular in shape with convex cutting edge, flat butt and with rectangular section and lenticular section on the longer axis. These celts are thinner than those reported from the Deccan chalcolithic sites of Jorwe, Nevasa and Chandoli.[629] A few unidentified objects have also come from phases Ib and Ic.[630]

Moreover, lumps of slag have also been recovered from the chalcolithic levels at Ahar (Phases Ib and Ic) K. T. M. Hegde points out that the presence of remains of copper-smelting industry in the form of metallurgical slag along with copper artifacts, in the chalcolithic layers at Ahar shows that Ahar was probably a chalcolithic copper-smelting centre. The fact that the slag was recovered from more than one

trench at three different depths, in the course of a restricted excavation of a vast archaeological deposit, further indicates that the copper-smelting industry at Ahar was probably extensive.[631] Further excavations at the site may reveal more about the copper-smelting industry at Ahar. The heaps of slag-like material were recovered in the trench of period I in a specially made round pit of about one-and-a half feet in diameter.[632] It is not known whether this pit was a part of furnace.[633]

Analysis of the slag material shows a very high percentage of silica in the composition, which indicates the probability of fluxing the copper ore. Hegde points out that silica may have been deliberately added during the smelting process as a fluxing agent or it may have been a part of the ore mass. But a quantitative chemical analysis of the sample of copper ore from Khetri indicated 16.70% silica in its composition, which is less than half of the percentage of silica in the slag. Hence, it is quite probable that the copper ore at Ahar was fluxed with silica by the chalcolithic smiths.[634]

The copper smiths of Ahar were not always very skilled as is evident from the high percent of iron (6.48%) present as an impurity in an axe of the Ahar Period I. This may have been due to inadequate temperature of smelting furnace of faulty composition of the smelting charge.[635] However, as Hegde also points out, this example of inefficient extraction of copper at Ahar was probably an exception. For the percentage composition of the metal sheet clearly indicates that in the extraction of the metal from which the sheet was made, iron was substantially eradicated. Percentage of iron in this specimen is only 1.2.[636] The analytical data also reveals that both the axe and the metal sheet from Ahar, that have been analysed, contain only a negligible quantity of arsenic and sulpher. This indicates a thorough roasting of crushed ore before it was smelted. If the crushed ore is roasted at a comparatively high temperature, above 500°C,

over a prolonged period of time, arsenic and sulpher in the copper ore get volatilised.[637] Presence of 1.62 to 1.64 percent of lead is also indicated in the analysis. But this small percent of lead was not deliberately added but was present in the ore.[638] D. P. Agrawal, is however, of the opinion that the Banasians were adding lead deliberately.[639] The subsequent analysis of Ahar artifacts reveal the same pattern of high iron content followed by lead. A lot of interesting hypotheses could be drawn if more data were available.

As to the metallurgical processes employed by the coppersmiths at Ahar, metallographic examination of an axe revealed that this specimen was cast in a crude unventilated sand or earthy mould and was left in the cast condition.[642] The technique of venting the mould was not employed by the Ahar smiths thus making the metal porous and the presence of dendrites and coring are indications of the cast condition of the metal. The sample was not subjected to work-hardening. The presence of cellular structure in the metal indicates that it was slowly cooled after it was cast. Slow cooling of the molten metal in the casting mould was probably brought about by covering the mould under hot ash.[642]

K. T. M. Hegde points out that the studies indicate that the copper objects of the Ahar chalcolithic were not imported but produced indigenously.[643] The metal was extracted from the Aravalli copper ore. Studies of the slag samples indicate that Ahar was a chalcolithic copper smelting centre.

The smelting technique of the Ahar smiths was quite advanced, beyond the stage of experimentation. There are indications to show that the ore was roasted before it was smelted and then fluxed with silica. The metal produced was relatively pure.[644] There was no deliberate alloying.

The unusually large 'Chulahs' or ovens that characterise some of the trenches at Ahar are very interesting. They may have been used to roast copper ore. Chunks of quartz were also found in the debris.[645] If the crushed quartz was used

for fluxing the ore instead of river sand this would indicate that the Ahar smelters had a deep understanding of the smelting process. For quartz is the pure form of silica and is much preferable to impure river sand as a fluxing agent.[646] However, their casting methods were not developed and the copper technology seems to be poor in comparison to that noted at the Harappan sites.

The large number of Ahar ware sites located in the Aravalli hills suggest that Ahar was perhaps not the only copper-smelting centre. Hegde puts forward that these sites in the Aravalli region supplied copper to meet the needs of various chalcolithic peasant communities settled in Rajasthan, Malwa and Gujarat.[647] In our course of study we have noted the role played by the Ganeshwar culture in the matrix of the protohistoric copper industry in this subcontinent. Hence it appears that from the third millennium to the second millennium the copper smiths in the Rajasthan were responsible for much of the development in the copper metallurgy in our context.

Here we may note the findings of copper artifacts at some of the small Ahar Culture site, Pind Padliya in the Chittor District, situated not far from the copper deposits of Bhinder and Bhadesara yielded six long celts of the Ganeshwar type. At Jhadol, in Udaipur District, vestiges of copper were recovered in association with Ahar pottery. At Ekalasimgha, District Ajmer a heavy bar celt was recovered in a field. The site is on the border of Bhilwara District and the unusual, heavy barcelt may belong to the Ahar complex.[648]

KAYATHA CULTURE

Towards the end of the third and beginning of the second millennium B.C. the Malwa region witnessed the emergence of a people who possessed some copper objects. Kayatha, 15 miles east of Ujjain, with the river Choti Kalishindh flowing near by, was the earliest settlement in the region to have harboured a people (Phase II) who used copper objects.[649]

These people were quite well-off in copper as from one pot alone twenty-eight copper bangles were recovered.[650] Moreover, a copper bar and a copper bracelet were also recovered.[651] Quite significantly, here we also note instances of bronze and bronze-casting, as is evident from the occurrence of a bronze bar, bronze bracelet and a copper wire.[652] D. P. Agrawal mentions that the two copper axes from the site with a sharp cutting edge and a lenticular section are the finest examples in the Bronze Age India. The axes were cast in a mould unlike the later chalcolithic specimens which were just hammered to shape in Central India and the Deccan. A chisel has also been recovered.[653]

MALWA CULTURE

The Malwa culture (C 1700 - 1400 B.C.)[654] flourishing in the Central Indian and the Deccan possessed a flourishing copper industry. Navdatoli has yielded a number of different copper objects viz.,[655] hooks, fragments of a thin copper wire and fragmentary pieces of copper.[657] Besides these we note the occurrence of flat copper celts with convex cutting edges,[658] arrowheads,[659] spearhead,[660] and also a shouldered axe at Navdatoli-Maheshwar.[661] The second report[662] on Navdatoli provide more data regarding metal artifacts. There were several celts or axes which could be categorised into four sub-types : (a) Crescenting cutting edge ; (b) Celts with elongated body and convex cutting edge : (c) shouldered celts and (d) celts with straight sides and convex cutting edge. Besides, chisels, fish hooks, a fragment of sword or dagger, four rods, a barbed arrow head. beads, rings and bangles have been recovered. The sword has a raised and rounded midrib on both sides. Lastly, there are fragmentary straps, sheet pieces, lumps and so on which might indicate recycling, secondary working and so on.

About the techniques practised, H. D. Sankalia and others point out that the chisels from Navdatoli were different from the Indus Valley chisels. The Navdatoli specimens were mainly hammered into shape. One specimen of the upper

portion of a chisel with convex top shows that it was not much hammered over in use. An intact specimen was hammered out of a long thin rod of copper, with only the three faces beaten smooth, one end of this was bevelled and flattened sharp, the other hammered to a point. This might be a chiselcum-point. Another has one end tapering to a truncated head and the other hammered flat to sharpness.[663]

As compared to the fish-hooks of the Indus Valley, some of which are barbed, the Navdatoli specimens present a variety devoid of barbed ends. One perfect and complete specimen with one end curved and sharp and pointed, the other hammered to a flaring, thin and torn edge possibly due to hard hitting. Another similar hook has a pointed slightly curved end and the other end hammered flat.[664]

K. T. M. Hegde reports that a full examination of a copper axe revealed that it contained 3.1% tin. Thus this axe was a low grade bronze object. The metallographic study of this axe shows that it was first cast, then subjected to hot and cold work and intermittent annealing to impart to it the present shape and the smoothness of the surface finish. A chisel from the site was also examined and found to have been cold worked and then recrystallised. After it was finally heated, it was not allowed to cool slowly, nor covered under hot ash while cooling. Instead it was exposed to the atmosphere. This resulted in quicker cooling and consequent fine grained structure.[664] The Navdatoli axes were cast in well-ventilated clay mould unlike the axes at Ahar.[665] D. P. Agrawal points out that lead was also alloyed upto 2% in the copper objects examined from Navdatoli.[666] No arsenical coppers are known. Thus in some respects the chalcolithic smiths in the Malwa culture context appear to have been more skilled than their counterparts at Ahar. However, the metal repertiore at Navdatoli was not very impressive. At Nagda, a Malwa site on the banks of the river Chambal, we also note a restricted use of copper.[666] At Eran, District Sagar, Madhya Pradesh, also copper is very scarce,

the finds including a circular copper object only from period I.[668]

JORWE CULTURE

Here we would like to point out that in the Jorwe levels at Daimabad a row of furnaces *in situ* were recovered. These furnaces, about one to two metres in diameter, are built of thick potsherds and plastered with mud and lime. Such furnaces had walls four centimetres thick with a hole in the bottom for molten metal to flow into sand-lined pits. One furnace has two openings to allow molten metal to flow into a pot placed at a lower level.[669] H. D. Sankalia points out that the question of the Daimabad bronzes having been manufactured locally cannot be overlooked altogether, in view of these findings.[670] Findings at Malwa and Jorwa phases include spearhead, razor, so-called mother goddess figures and copper lumps. Remains of copper-smith's workshop are identified with furnaces containing ash as well as crucible.[671]

At Jorwe, the type site of the Jorwe culture in the Ahmednagar District in Maharashtra, we encounter the use of pure copper in the making of the Jorwe bangle. It was made from a cast rod which was cut later to necessary size. Though annealing has taken place it could not be determined whether this was intentional or otherwise.[672] D. P. Agrawal mentions that the Jorwe axe has a 1.78% tin content.[673]

At Nevasa, in the same district, we note indiscriminate use of copper and low grade bronze. Spectroscopic analysis of a copper chisel, bangle and a bead from the chalcolithic, i. e. Jorwe levels (Period III) at the site shows that the chisel contained 2.72% tin, whereas the bangle and bead were almost cent percent copper (98.31% and 99.06% respectively).[674] The copper repertoire of the Jorwe people at Nevasa comprise two bangles ;[675] seven beads of the biconical, truncated barrel and long barrel types ;[676] one blade ;[677] one chisel ;[678] one poker ;[679] one rod ;[680] and one bowl.[681] Metallographic analysis of the biconical beads, found in a small high-necked pot near a burial of the chalcolithic

period, showed that they were made by hot hammering. A copper sheet of 3 to 4 mm thickness was so wrapped as to form a cylinder and then pressed to a biconical shape. The joint of the two ends of the sheet is still visible. The other beads of the chalcolithic period were hollow and very light and seem to have been made of copper sheet.[682] The object that has been identified as a blade is almost triangular with one side slightly convex, made of copper sheet. It looks like a sharp axe with two sides concave and the cutting edge convex. It was possibly tied to something when in use.[683]

The Nevasa chisel is a rectangular rod with a sharp double sloped edge. That it was made by hammering a circular rod into a rectangular one is indicated by the overlapping edges of the body.[684] Spectrographic analysis indicates that the addition of 2.72% tin might be deliberate. The report states that the structure consists of a fine grained single phase alloy. There is indication of hot forging of the specimen after casting. It appears that the forging process was finished just above the recrystallisation temperature of about 500°C.[685] Another object consists of a long, thin copper rod with one end tapered to a very sharp point and the other bulbous and solid. This might have been used as a poker or a needle for engraving or nail-cleaning.[686] The copper rod is solid and heavy.[687] The copper bowl, found near a skeleton, is rimless with flat edge and thin sides.[688]

The Jorwe site of Chandoli, District Pune, has yielded quite a few copper objects, including two chisels with levelled edge and square section ; a celt with straight sides and slightly convex edge ; leg ornaments ; and a dagger having leaf-shaped, midribbed blade and a long antennae-ended tang ;[689] as well as an axe and a spearhead.[690] The excavators, Dr. S. B. Deo and Z. D. Ansari, point out that this dagger is the first of its kind so far found in India in a stratified context.[691] D. P. Agrawal points out that this antennae-hilted sword has been compared with similar swords from Fatehgarh, the Copper-Hoard site in Uttar

Pradesh. However, he points out a few differences. Firstly, the Chandoli specimen is a dagger having a total length to breadth ratio of 1.6 only in comparison to the ratio of 5 in case of the Fategarh specimens, which belongs to the category of swords. Moreover, the Fatehgarh specimens are massive with a sharp median ridge and cast antennae hilt. The Chandoli specimen is light, with a diffused median ridge and the hilt is made by cutting with a chisel and hammer.[692] The antennae were thus very small and possibly made to prevent slipping of the tang from the wooden haft.[693]

K. T. M. Hegde and H. D. Sankalia point out that the axe and spearhead from Chandoli showed no traces of tin when analysed and lead was present in 1.68% in the axe. The axe was made by unsound casting technique. The mould was not provided with proper ventilation as in the case of the Ahar axe. This specimen from Chandoli was subjected to hot work and was allowed to cool slowly, under cover of a hot ash. It was not subjected to work hardening.[694] From this it is concluded by Hegde that while the cutting edge of the specimen was shaped by hammering of the hot metal the body of the axe was not subjected to forging.[695]

At Inamgaon, also in District Pune, we note interesting evidences for the position of craftsmen, especially the copper smiths in what may have been a stratified society. M. K. Dhavalikar points out that distinguishing feature of the pattern of the Jorwe settlement here is the location of the craftsmen's quarter on the periphery of the habitation. These houses could be identified as belonging to specialised craftsmen from their contents. In the Early Jorwe Period here one could distinguish the quarters of potters and copper smiths, in the late Jorwe, those of gold smith, lime maker, wine distriller, potter and copper smith.[696]

Dhavalikar reports that copper objects have been recovered from all the occupational phases and the remains of furnace for smelting of copper have been found in the middle levels of the Period II (Early Jorwe). A lump of copper

ore came from the late levels of period (III) (Late Jorwe). This shows that the copper ore was smelted at the site and that the objects were manufactured locally. The furnace lay just west of the pottery kiln in Period II.[697] It is a boat-shaped structure built of clay on stone foundation and by constant use it has been completely baked. An oval clay cushion, similar to that from the Kiln, was found in the centre of the furnace possibly for keeping the ore. It, however, had no perforations. Dhavalikar points out that stylistically, the structure bears resemblance with the bronze age furnace which are dated to the middle of the second millennium B.C.[698]

Inamgaon has also yielded gold ornaments in the shape of beads (long, barrel and circular) from the Late Jorwe Period. M.K. Dhavalikar also reports a goldsmith's crucible and a pair of tongs of copper from the craftsmen's quarter from this level. It seems that the gold for Daimabad as well as Inamgaon was obtained from Karnataka in South India.[699] The above survery of the metal works of the Central Indian and Deccan Chalcolithic contexts shows that these were in most cases probably produced indigenously. The furnaces at Daimabad and Inamgaon, especially, are significant pointers to this direction. Further, as K. T. M. Hedge points out, the studies indicate the presence of low-grade bronze objects. It is possible to infer that the chalcolithic copper smiths knew that when copper was fused with small quantities of tin, the resulting alloy produced implements with harder, keener, more enduring cutting edges. But paucity of tin appears to have restricted their production of bronze tools.[700] There is no indication of arsenic alloying. Metallographic studies reveal that the chalcolithic axes were cast while knives and chisels were wrought.[701] But the cutting edges of the axes were not entirely a feature of the casting mould but were bevelled by further hot and cold work. the Navdatoli axes were cast in well-ventilated clay moulds, while those from Ahar and Chandoli were cast in crude unventilated moulds. Thus, local

variations in metallurgical processes are indicated.

It would be interesting to know whether these early metallurgists formed a class by themselves, and if there was a division of labour within the class like miners, smelters and smiths. The evidence from Inamgaon indicate that already a class of specialised craftsmen, with seperate quarters and working areas, had evolved among whom the copper-smiths must have held an important position. However, their quarters on the periphery of the settlement indicate that they did not hold high positions in the stratified society which was probably enjoyed by the priests or administrators.

As to mining, it is most likely that the miner extracted and smelted the ore near the mines and then carried the extracted ingot around the habitation centres and cast or forged the objects in accordance with the demands of the peasants, and other craftsmen as well as householders and warriors. K. T. M. Hegde suggests that alternatively the itinerant chalcolithic caster with his moulds and forging tools perhaps travelled through the regions calling at regular intervals on the smelters who lived within the ore belt in the Aravalli hills to replenish his supplies.[702] Thus a constant communication between the people near the regions of the ore-deposits and those in the far-off regions who used the finished tools was quite established. Both Hegde[703] and D. P. Agrawal[704] think it likely that the Rajasthan copper deposits might have supplied the raw material to the copper smiths in the Deccan and Central Indian Chalcolithic contexts.

The above survey also reveals that basically the chalcolithic people in the Central India and Deccan in the second millennium B.C. were backward, as far as quantitative use of metals is concerned, compared to the Harappans. Their techniques were less efficient especially as far as casting, annealing, running on etc. go. Moreover, instances of alloying are rare. This may have been due to

the scarcity of tin in these regions. However, the presence of a few low-grade bronze examples from the sites of these regions imply that at least in a few cases the chalcolithic smiths knew the technique of bronze alloying with the utilisation of tin. Moreover, these chalcolithic people in the Deccan and Central India did not possess such quantitatively rich and varied types of copper and copper-bronze implements. Thus there was a great quantitative as well as qualitative gap between the metal industries of the Harappans and the Deccan and Central Indian chalcolithic folks. What laid a great restriction on the development of these cultures into greater civilizations was perhaps the ecology of these regions which restricted agricultural activities in these contexts. We must note that the Ganeshwar Culture in Rajasthan occupies a singular position in this whole picture of the development of copper metallurgy in our sub-continent throughout the third and second millennia B.C. It stands in-between, acting as a supplying zone both for the Harappans, Late Harappans, and the Chalcolithic folks in the Central India, Deccan and the Doab regions, although manufacturing and smelting must often have been carried out locally in both cases. The varied tool typology typical of these different cultures emphasis this point of local manufacture.

SOUTHERN CHALCOLITHIC

In the South India, only two sites have yielded evidences for the existence of a stratified chalcolithic context, preceding the Iron-Age or Megalithic context. These are Hallur and Tekkalkota, both in Karnataka. At Maski, Raichur District, Karnataka, we note the occurrence of chalcolithic element in Period I of the occupational sequence. However, as mentioned earlier in Chapter I, the use of metal here is evident from only a single rod of indeterminate use from a mid-level of Period I. As the excavator B. K. Thapar himself points out, the presence of this lone specimen of metal in an otherwise all-purpose use of stone 'clearly indicates the slow infiltration of the metal in an essentially neolithic culture.'

At Hallur, District Dharwar, we note an intrusion of the chalcolithic element in the Upper Neolithic levels. Copper implements here comprise miniature double-edged axes made of flat copper sheet and fish-hooks.[705] The double-edged axe, of which two examples have been recovered at this site, has a butt which is as sharp and round as the primary working edge. The butt portion is shorter and narrower than the primary working end. S. P. Gupta points out that it is exactly the feature of the 'double-edged axe' found at Bhagrapir, Orissa in ten numbers.[706]

At Tekkalkota, District Bellary, a copper axe was recovered in the earliest excavation at TKT-1 Period I. Interestingly a few gold ornaments like ear ornaments or pendants have also been found in this context.[707] In the Period II levels a few copper objects like rings and wires were recovered during this first excavation.[708] Subsequently, a large-scale excavation at TKT-1 revealed the occurrence of several copper objects, including bangles, fish-hooks, poker and wires, Noteworthy is the discovery of a copper wire retained in the perforation of a steatite cylindrical bead. A gold ornament was also recovered.[709]

The occurrence of gold ornaments at Tekkalkota in Karnataka is a most likely incident. It is very much probable that the Late Harappans at Daimabad and Late Jorwe folks at Inamgaon obtained gold from such ancient settlers in the South India as the inhabitants of Tekkalkota. It may be noted here that the occurrence of the white painted black-and-red ware bowl at Tekkalkota (II), tends to show that contacts had existed between the people here and the chalcolithic folks in northern Deccan.[710] The chalcolithic folks in the South India were probably using pure copper and did not employ the technique of alloying. K. T. M. Hegde's analysis of the Tekkalkota axe from Period I revealed that it contained no tin, but only trace elements.[711] An observation that can be made about the Southern chalcolithic complex is that almost no evidence of local smelting is available at the sites.

BLACK-AND-RED WARE CONTEXT

Coming back to the Ganges-Yamuna Doab region, we note that copper was being introduced at a few sites here in the Black-and-Red Ware context. At Atranjikhera in District Etah we encounter the copper objects for the first time in these levels. They comprise a ring, broken in two pieces ; a squattish drum-shaped bead ; a squattish cylinder bead and an unfinished bead.[712] Chirand, District Saran, in Bihar, has yielded a few pieces of copper in the top layers of Period IA, characterised by the Black-and-Red Ware.[713] In Bihar a neolithic-chalcolithic overlap phase has been detected at sites like Chirand,[714] Taradih,[715] Oriup,[716] and Sonpur.[717] These sites have yielded meagre assemblages of copper comprising rings, lumps, unidentifiable pieces etc.

In West Bengal, the site at Pandu Rajar Dhibi in Burdwan District has yielded copper objects from period II, dated in the second millennium B.C.[718] These comprise spiral bangles and rings as well as eye-pencils and a fish-hook and these often reveal delicate workmanship.[719] It may be noted that this period is also characterised by the occurrence of the Black-and-Red Ware and the lustrous red ware.[720] Mahisdal in District Birbhum, yielded a flat copper celt with a convex cutting edge, in the period I levels, which is characterised by the Black-and-Red Ware, plain or painted.[721] Excavations at Bharatpur,[722] on the left bank of Damodar river have yielded a lot of evidences for a chalcolithic phase of occupation. Period I yields the Black and Red Ware at a neolithic stage. Period II is marked by the appearance of the chalcolithic phase indicated by the presence of copper bangles, a wheel turned Black and Red Ware producing such sophisticated shapes as the channel spouted handis, long-necked jars and dishes on stands. Interestingly, a large number of iron objects have also been recovered from this phase indicating a possible overlap between chalcolithic and iron age phases. The earliest chalcolithic level is datable to 1450 B.C. The twin sites of Baneswardanga and

Santaldanga, north of the Burdwan town, have yielded assemblages belonging to the chalcolithic phase. Fragments of copper points have been recovered at the former site and a number of spiral bangles of copper have been found at the latter site as a part of grave goods. The diggings were carried out in a very limited slope.[723] More evidences might come to light on further excavation. Mangalkot in the Burdwan district has been excavated quite extensively yielding interesting results. Period I at the site marks the chalcolithic phase. However, the use of copper was very much limited comprising only fish-hooks and ornaments. But iron equipments come from almost the bottom layer of this phase. However, the quantity and quality were insignificant at this stage. But in the transitional phase from chalcolithic to the historic — Period II, the use of iron become more prolific comprising tools like pick, chisels, sickles, arrowheads, fish hook, swords etc. Moreover huge oven-like space have been discovered at this level, covered with thick layer of ash containing iron slags and half-finished iron tools. The chalcolithic period ranges in date from 1200 B.C. to 600 B.C. and the period II phase begins around the 600 B.C. times.[724] Lastly we may mention that chalcolithic phase had been located at Bankura district of West Bengal where at the site of Dihar fragments of copper have been discovered in Period I sequence.[725]

We may also note here that copper and perhaps copper metallurgy had also reached the distant neolithic sites in the Kashmir Valley, such as Burzahom. At this site, the Phase II levels yielded copper arrowheads and a coil. Subsequently a few copper objects including a knife and a double edged point were recovered from phases III and IV.[726] We have a single C-14 date for phase II, 705 + 105 B.C.[727]

What we note above is the fact that by the end of the second millennium B.C., copper as a metal had begun to be recognised as a perfect raw material for implements, weapons and ornaments in not only the Indus Valley, western Punjab, Rajasthan and Gujarat — the zones of the Harappa Culture,

but beyond. The lesser cultural contexts from the northern regions of the Indian sub-continue (Kashmir Valley) to the southern (Karnataka), and from the Western (non-Harappan sites in Gujarat like Somnath) to the eastern (West Bengal), were becoming aware of the utility value of metals. So far the only metal available that could be used for manufacturing weapons and implements was copper. It was being used abundantly for different purposes.

However, except for the Ganeshwar-Jodhpura culture and the Copper Hoards in the Rajasthan, Ganga-Yamuna Doab and the peripheral regions, copper implements were not as abundant as in the Mature Harappan assemblages in the latter half of the third millennium B.C. The evidence for the role of the metal industry, i.e. copper industry, in the second millennium B.C. is rather less impressive than that noted in the previous millennium in the Harappan context.

In the second millennium we have the Late phase of the Harappan culture in the Western regions, the neolithic-chalcolithic complex in the peninsular and southern region and the Copper Hoards in the Doab and eastern region, approximately. It is quite evident that there were cultural and economic communications between all these complexes. The presence of the shouldered axe at Navdatoli, the antennae-hilted dagger at Chandoli, the double-axe at Hallur and the shouldered axe from Midnapur and the anthropomorph and double-axe at Lothal, seem to indicate that industrial relationalship existed between the Copper Hoard folks and the Late Harappans on one hand and the former and the neolithic-chalcolithic cultures in the Central India, Deccan, eastern India and the southern India, on the other.[728] As S.P. Gupta points out all these complexes were mutually contributing and borrowing something of the other.[729] In the sphere of pottery too, as he points out, the Harappans had much to contribute to the painted Black-and-Red and black-on-red of the neolithic-chalcolithic wares on the one hand and to the red ware, the ochre coloured ware likely to be associated with the Copper Hoards on the

other. He further goes on to state that the neolithic chalcolithic culture with its pottery, burial customs etc. travelled into West Bengal, in the Valleys of Ajay, Kunoor, Bakreswar, Kopai and Mayurakshi.[730] However, basically, cultural differences in the various regions existed very much. Glaring dissimilarities and disparities in cultural evolution and all-round development of the societies and economics existed. The metal repertoire of these different cultural complexes reflect these differences, as we have seen above. A few instances of exchange and copies do not at all indicate a standardised metal industry for all these regions. The supply of raw material, copper, etc. varied for each complexes in each region as we have also noted. The subsistence life varied greatly in each of these contexts. Thus each of these cultures maintained their distinct identities in the various eco-geographical contexts while maintaining economic and socio-cultural communications with each other. These regional distinctions and disparities between the cultural development in each context is evident in the growth of the metal industry.

We shall see that when the Iron Age dawned in this subcontinent, around the beginning of the first millennium B.C., the iron metallurgy did not appear simultaneously in all the regions. The eco-cultural barriers existed still and some regions advanced quickly in the field of iron metallurgy than others for various reasons like availability of raw material and the geographical locations facilitating a surplus agriculture etc. that would lead to greater cultural expressions.

VI

THE IRON AGE

The first half of the first millennium B.C., saw man handling a new metal in the Indian subcontinent. The appearance of iron was to add a new and extremely significant dimension to the history of metallurgy in this subcontinent. Not only that, iron and iron-metallurgy was associated with a series of developments in the whole

economic structure that in its turn generated socio-cultural developments of some magnitude. Although, iron metallurgy was not directly linked with these processes in many cases, but, nevertheless, it triggered off the motion of changes that were to have significant results. The fact that has the most important bearing here is that iron is more abundantly available in the form of ore in the earth's strata than any other metal in our subcontinent. The ancient smiths came upon this metal and got to appreciate its great utility in making tools, weapons etc., the abundance of the iron-ore became the focal point in favour of the rapid adoption of the metal in every walk of life.

IRON METALLURGY :

We may note that the development of iron metallurgy in this subcontinent had a wonderful background in the copper-bronze industry that we have so long noted to be flourishing. Now, there existed a highly skilled class of men, who were able to perform intricate metal production and fabrication processes and were adept in pyrotechnology. As T.A. Wertime points out it was in the process of working on copper and lead that man first chanced to come upon iron. He states that everywhere, iron first became known to men in a very low carbon form.[731] This was true because the smelted iron was first accidentally discovered in the guise of high-iron slags occasionally produced in furnaces for lead or copper.[732] We may also note here that it may have been the accidental use of iron oxide as a flux for smelting copper that led to the discovery of iron as a seperate metal by itself. As J.A. Charles points out, the most readily available and useful fluxes for copper smelting would be found in the iron oxides, particularly limonite, which was available from the gossans associated with a copper deposit.[733] These gossans, although enriched in iron by substantial separation of the copper, also contain some copper salts and could have been initially included for this reason. The incorporation of iron oxide as a flux for the gangue would give fusible slags, with melting

points usually below the temperatures attained in the furnaces i.e., 1400° centrigrade.[734] The presence of some form of iron in the raked-out fire, in the copper-furnace, which proved to be similarly ductile as copper when forged hot under the hammer, even if of different colour than copper when cold, would have been quickly noted.[735] As we have noted above, the first smelting of iron took place at temperaturs lower than the melting point of iron. The copper smiths of the early days could not produce as high a temperature as 1400°C. in their furnaces which were made for producing copper. As T.A. Wertime points out the first iron known to the people was doubtless a low-carbon iron.[736]

It was in Anatolia that the bronze-silver workers produced the first iron objects in the third millennium B.C.[737] From there, it is a long time-span when we encounter the first iron-bearing contexts in our sub-continent around the first half of the first millennium B.C. The reason for the late advent of iron here may have been due to the fact that the iron metallurgy had quite different working methods from that of the copper metallurgy. First and foremost is the fact that iron could not be made fluid in furnaces being used by the copper metallurgists for while iron required a very high temperature to melt, viz., 1540°C, the copper metallurgists were capable of creating a temperature of 1083°C., that was the maximum required for melting copper.[738] Although William Gowland points out that temperature needed to reduce iron was only 700-800°C and that the early copper smiths were already smelting copper which required a temperature of about 1100°C,[739] Coghlan points out that although it is possible to extract iron at temperatures of 700-800°C, it is the molten liquid obtained at a temperature range of 1000°C to 1100°C that is really suitable for working and forging. Melting of iron, as we have noted, required an even higher temperature.[740] The melting of iron was more necessary for while copper and bronze were usually cast in

moulds and the necessary forging was done by cold work, the iron objects had to be forged stage by stage from a bloom to a bar and then come the processes of thining, pointing, folding and forge-welding — which all require a high temperature (white heat) that can be brought about by the use of forced draught.[741] The early iron metallurgists learnt after long experience, that iron ore could be reduced to a bloom only under a particular set of conditions and a slight change in the conditions would not result in a workable bloom.[742]

R.F.Tylecote observed that the most primitive type of furnace for making iron is the bowl furnace which is not more than a hole in the ground or rock into which air from bellows could be directed through a tuyere and having a short, probably dome-shaped, superstructure of clay. The broken ore and the charcoal would be mixed together or charged in layers onto a hot charcoal fire.The maximum temperature should be atleast 1150°C for even a low carbon iron.[743] K.T.M. Hegde suggests that in the absence of good and direct evidence for iron-smelting furnaces in Indian history, one may take recourse to the models of primitive technology of iron smelting practised by the Ghadi Loharias or Agarias, a peripatetic, iron-working community of Gujarat, who may have retained the age—old historic practices in some vestiges. These people employed simple techniques. The metal was extracted in the form of a spongy mass by direct reduction of the ore in a simple cylindrical, clay-lined, crucible-shaped shaft furnace or a seventy five cms. high, cylindrical clay Klin which had provision for an airblast blown in by bellows.[744] These indigeneous pre-industrial iron smelting furnaces had been described earlier by Tylecote also.[745] Therefore, as H.C. Bharadwaj points out, it was not until the middle of the second millennium B.C. (C 1500 B.C.) that the real break-through occurred in iron metallurgy. He suggests that these reasons would also apply for the late arrival of iron metallurgy in India.[746]

From the excavated sites in West Bengal presence of iron slag, remnants of crucible, tuyeres and furnaces are found which indicate local smelting at the concerned sites. The primitive tradition of iron smeling detected in this state as well as in Orissa and Madhya Pradesh were fundamentally similar, however there is no indication that the development of iron technology was unicentre. Parallel developments took place in the wide regions where the ore was abundantly found and where earlier metallurgical tradition might have existed. The stages involved were : the gathering of ore, mostly from out crops and surface veins ; sorting, cleaning and preparation of the ore ; making of charcoal from jungle wood ; construction of the furnace from tempered clay ; rigging bellows for blowing air for combustion ; the smelting operation was done in a pear shaped vertical shaft furnace with two openings at the bottom. One of these was for inserting the muzzle of the bellows and the other for drawing out the slag. For satisfactory removal of slags smelting is prefered around 1200°C.[747]

In this context, it may be pointed out that a close connection has been found to have existed between the movement of Indo-Aryans and the wide-spread use of iron in the Near East, towards the end of the second millennium B.C., by many scholars like Ghirshman.[748] D.H. Gordon had emphatically pointed out that before coming into India and Aryans lived on the Iranian soil.[749] In fact the Gomal and Kurram Valleys, as we have seen in our Chapter-II, were mentioned in the Rg Veda. N.R. Banerjee points out[750] that, – "In view of the Aryans and Iranians living together for a considerably long time and the passage of the latter through Iran on their way to India, it was impossible for the Aryans to be blind to the use of iron objects in peace and war, contemporansously in vogue in Iran .... It is also likely that they employed this metal themselves." From here, he proceeds on to state that in the circumstances it may have been so that the Aryans after taking sometime to settle

down properly in India, set out to look for the ores to set up their own industries. However, there is a very big gap in time, of more than five hundred years between the first influx of the Aryans into India and the occurrence of iron artifacts here. Hence, nothing definite can be said, as yet, about the originators of iron metallurgy in the context of the Indian subcontinent. Moreover, we have already noted how the metal smiths chanced upon iron while dealing with copper in the protohistoric context. Hence, we cannot rule out the possibility that the indigenous copper smiths had tumbled upon iron and through repeated experiments obtained the true knowledge of iron metallurgy on their own.

INTRODUCTION OF IRON IN INDIAN SUBCONTINENT

The Iron Age in India, as the picture is now set, arrived on the threshold of the Indian subcontinent around C 1000 B.C. The early occurrences of iron are noted in a few regions in the Indian sub-continent, viz., in the north-west at Pirak in the Kachi plain and the Swat Valley graves, (the date for cairn-burial sites is uncertain and Dilip Chakraborti has shown in some details that as far as available data show they may not be earlier than the first century B.C.) ;[761] in the Ganges-Yamuna Doab at Hastinapur, Atranjikhera, Alamgirput, Jakhera and Allahapur ; in Rajasthan at Noh; at Ahar in Southern Rajasthan, in the Central Indian sites like Nagda, Eran, Bahal and Prakash, Ujjain etc. ; in the southern India in the Megalithic complex, the earliest occurrence being perhaps noted at Hallur in Karnataka ; in Maharashtra at the Vidarbha Megalithic sites like Takalghat-Khapa ; and in the eastern India at Sonpur, Chirand, Mahisdal, Pandu Rajar Dhibi etc. The occurrence of iron at these sites ranges in time from C 1000 B.C., or more probaly C 800 B.C. onwards.

The Iron Age truly begins when iron ceased to be considered precious and was finally accepted as the predominant material for making tools and weapons. This era, as Jane C. Waldbaum points out, first reached fruition

in about the tenth century B.C. throughout the regions stretching from Greece to the Levantine coast and around the ninth century B.C. in Mesopotamia and somewhat later in Europe and regions farther to the east.[752] In the Indian sub-continent, as we have already noted, iron appeared late around C 1000 to 800 B.C. Now we shall see whether the iron assemblages at these early sites fulfil the requirements that we have described above as essential for the constitution of the Iron Age in the proper sense of the term and when to place its beginning.

BALUCHISTAN :

Pirak in Baluchistan is a remarkable site which gives a continuous sequence of occupations from the Copper-bronze Age to the Iron Age throughout its eleven-level stratigraphy.[753] The upper six levels at Pirak has yielded iron, the main tool or weapon type being a winged arrowhead.[754] The earliest occurrence here is at level 6 where iron is found in a small quantity. Its use increases in level 4 and specially in level 3. Several two-winged arrow heads have been found. one lying with bits of iron, mixed with a huge quantity of ashes near small apsidal oven.[755] This last piece of evidence may indicate either that iron was being forged locally or that the arrow-head type tool was being in used in some manner so that it got to be associated with the oven and ashes. In fact a number of ovens, fire places and artifacts associated with metal craft have been detected. The former hypotheses is more likely to be correct. We must, however. note that at Pirak, despite the increasing use of iron, the serrated stoneblade industry also continued.[756] Two carbon samples from the fourth level at Pirak provide dates of about C 755± 105 B.C. and 810 ± 125 B.C. A sample from the fifth level closely connected with the fourth, gives a date of 785± 105 B.C. Thus the iron age horizon at Pirak may be dated around C 800 B.C.[757]

GANDHARA GRAVE CULTURE :

In the Swat Valley, lying north-northeast of Peshwar, marked by Indus on the east, the Kunar-Chitral on the west, Chitral on the north and the Peshwar plain on the south,[758] the occurrence of iron is associated with the Gandhara Grave Culture. As G. Stacul points out, only a single iron object may be ascribed to the Period V sequence of the general sequence of Swat Valley Culture (from the end of the second millennium to the beginning of the first millennium B.C.) It consists of a fragments of a laminar, a highly oxidised object, found in the Katelai graveyard.[759] But in the protohistoric graveyards of Loebanr, Katelai and Butkara II, no other iron finds can be ascribable to Period V or even to Period VI. It is only in Period VII contexts that graves not only yielded copper but also iron objects. This period cannot be dated before the fourth century B.C. according to Stacul.[760] He, therefore, concludes that the Iron Age did not begin before the 4th C B.C. in the Swat Valley.[761] However, A.H. Dani puts the iron bearing levels to his Period III sequence which according to him dates between C 900-600 B.C.[762] D.K. Chakrabarti points out that in the present state of our knowledge there is not enough evidence to be more positive about the date of the beginning of iron in the Swat Valley except to say that it may be placed somewhere in the first half of the first millennium B.C.[763]

We must now turn to an appraisal of the iron assemblages at the Swat Valley sites. Among the grave sites. Timargarha has yielded and following iron objects, a mid ribless spearhead, discheaded nails, a spoon with the handle terminating into two rings one on each side, a cheek-bar of horse's harness which consists of a rectangular sectioned straight bar with three elliptical holes made at equal distance from each other, the ends being provided with one knob each. This last piece is quite interesting and reflects a great deal of observation, creative and innovative drive as far as the fashioning of the object goes, on the part of the smith

who produced it. If it truly belonged to a horse, that animal must have been a prize beast for drawing so much attention. From Katelai a lot of iron objects, mostly in fragments, have been recovered from the numerous tombs. They include spearheads, axes, several fragments of pins, fragment of an arrowhead, and miscellaneous fragments.[764] Butkara II has also yielded sundry miscellaneous fragments mostly. Besides these a spear with both the shaft and head of iron and another fragment of a spear have been recovered.[765] The complete spear with iron shaft is definitely an improvement upon the spearhead so far encountered among copper as well as iron assemblages. From Pulanr a leaf-shaped spearhead, a javelin head and a pin has been recovered. From Noghurmari has come two barbed and tanged arrowhead.[766] At the settlement sites of Balambat and Aligrama a very few pieces of iron were recovered, for example, a blade of a knife and three other fragments probably belonging to some nails from Balambat and a few fragments of iron for Aligrama.[767]

We may note that out of the 121 excavated graves at Timargarha only 5 bore iron objects, out of 183 at Loebanr also only 5 yielded iron objects and at Katelai 13 graves yielded iron out of the 243 excavated, while at Butkara II iron is encountered at 9 graves out of the 48 excavated.[768] Moreover, as we have noted above most of the artifact is fragmentary and unidentifiable. Among those that can be distinguished the spearhead numbers most. The complete spear with iron shaft and the cheek-piece of horse are very interesting, however, unless more such objects are recovered from these Swat Valley sites we cannot be definite about the height of skill attained by the blacksmiths or whether these objects were produced locally. A number of radio-carbon dates are available for the Swat Valley grave sites, for example, Loebanr has two dates - 1120 ± 154 B.C. and 985 ± 154 B.C. ; Timargarha has two, - 1530 ± 150 B.C., 750 ± 130 B.C. and 1220 ± 180 B.C. Thus the first

appearance of iron the Swat Valley region is dateable to C 1000 B.C.[769]

About the Cairnburial sites in Baluchistan and Makran extending to Iranian Baluchistan as far as Fars and Kirman is Iran, we have already noted that the dates of these sites are quite uncertain and hence it would be confusing to discuss the evidences therefrom in order to get a clear picture of the early stage of Iron Age in the Indian subcontinent. however, we shall mention some evidences from the Cairn-burial sites in the passing, later on.

RAJASTHAN :

Next we turn to the iron-bearing levels at Ahar in southern Rajasthan which has been put between C 1300 and C 1000 B.C. by the Allchins.[770] M.D.N. Sahi points out that iron at Ahar begins to appear in the upper deposits of period Ib and continues to occur in period Ic, which is dated between C 1270 B.C. and 1550 B.C. by carbon samples. He thus suggests that the introduction of iron at the site may go back to the sixteenth century B.C.[771] For proof of his theory he cites the evidences from Layer 5 of Trench X which represents the upper-most layer of period Ic. From this deposit came to dish-on-stand and the Lustrous Red Ware besides the painted Black-and-Red Ware. It is this very deposit that has also yielded two iron arrowheads measuring 9.7 cms. and 10.9 cms. respectively. The charcoal sample of TF 31 that gives a date of 1270 B.C. was also collected from this layer, thus dating this level to the beginning of the thirteenth century B.C.[772]

Here we may note that, the excavation report on Ahar states that in the Trench X with a depth of 10ft. one can witness the transition from the copper Age to the Early Iron Age. However the excavators state that : 'From the associated objects : legged querns, tanged and socketed arrowheads of iron, also ornaments of shell and clay as well as ring well, the structure can be placed in the early centuries of the

Christian era, though the discovery of a coin of Apollodotus might suggest an earlier date.[773]

M.D.N. Sahi has however, also cited the evidence[774] that in Layers 2 and 3 at Trenches H-I, a lot of copper as well as iron slag occur which is loose ashy gray in Layer 2 while in layer 3 otherwise compact and brownish in colour'.[775] The report goes on to state that besides charcoal pieces, these layers also yielded small objects like terracotta beads, figurines, sling stones, hammer stones and bones.[776] Thus, the excavators point out in the report. Sqs. H and I supply important evidence of two industrial activities at Ahar.[777] Thus, it is definite that iron-smelting was being done at Ahar. However, the date for this is not very certain. It may only tentatively be said to have begun in the thirteenth century B.C. D. K. Chakrabarti agrees that iron at Ahar may go back to the first quarter of second millennium B.C.[778] However, this suggestion that it may go back to the sixteenth century does not seem to hold water. We may now look at the list of iron objects recovered at Ahar. These comprise fourteen arrowheads of leaf-shaped, rhomboid. thin and long, thin and triangular and elongated triangular types : three chisels of which one was difinitely a carpenter's tool with one end narrow and sharp ; one axe or adze ; two nails; two rings, two pegs and a socket.[779] It appears that the blacksmiths at Ahar were producing some tools for craft etc., and some weapons.

The site of Noh in district Bharatpur, Rajasthan. has yielded the evidence for the introduction of iron in the Period III (PGW).[780] We may note that four radio-carbon dates are available for the PGW at Noh, viz., 605 ± 260, 820 ± 225, 725 ± 150, and 490 ± 90.[781] We must note that there is some discrepancy in these dates which may occur due to their having been taken from disturbed layers.[782] More recently, B.B. Lal has put forward that the beginning of the PGW occupation at Noh may safely be placed sometime in the eleventh century at any rate before the 1000

B.C.[783] The iron objects recovered from this context comprise spear-heads, an arrowhead with a leaf-shaped point and a socketed tang and an axe with a broad cutting edge.[784] Here it would be extremely relevant to refer to the evidence of iron smelting that has come from Jodhpura in Rajasthan. A crucible-shaped furnace has been discovered which was probably used for direct reduction of ore. The bloom was likely to have been heated in an open furnace and was forged on an adjacent platform. Some lumps of ore were also discovered which occur commonly in the nearby mines of Bania Ka Bas, Morija etc. in the Jaipur distric.[785]

SOUTHERN INDIA :

At Hallur, Dharwar District, Karnataka, in South India, the first iron-bearing level has also been dated quite early. Here the overlapped phase of Upper Neolithic-Chalcolithic-Megalithic (Period II) saw the sudden emergence of iron implements such as arrow-heads, spear heads etc. along with the introduction of Black-and-Red Ware including that with the white-painted decoration.[786] The excavator points out that this period II witnessed the arrival of new people at the site with iron arrow-heads, spearheads, daggers and knife blades. They used the above-mentioned distinctive pottery. While the earlier Neolithic-Chalcolithic inhabitants buried their dead under house floors, these people appear to have disposed their dead away from the village.[787] A series of radio-carbon dates show the appearance of iron at the site around 1000 B.C.[788]

Subsequently the excavator reports that further excavations at megalithic sites located near the village of Tadakanahalli in Karnataka revealed the occurrence of white-painted black-and-red ware bowls and iron arrowheads, daggers, nails, axe and spearheads. M.S. Nagaraja Rao, on the basis of the occurrence of the above-mentioned ceramic and the similarity of iron tools with those from Hallur, holds these graves to be dating around

the 1000 B.C. approximately.[789] The various categories of iron objects found at the megalithic sites in the South India may be listed to comprise-flat, cross-banded and single banded axes ; flanged spade ; hoe ; sickle ; flanged pick-axes ; stone-cutter's wedges ; pointed bars and crow bars ; knives ; swords ; chisels ; adzes ; spearheads ; daggers ; arrowheads and other miscellaneous objects.[790]

However, unlike the situation at Ahar, here in the Karnataka megalithic context it appears that the iron implements were perhaps not locally manufactured as early as the 1000 B.C. but brought into this region by a new people. The origin of these new people add to the problem as to who were the first iron — using people in this sub-continent and whereform they came.

CENTRAL INDIA :

In Central India, the site of Eran, in District Sagar, Madhya Pradesh, has yielded iron in an early level in Period II which is placed around the 13th C. B.C. by radio-carbon dating.[791] However, As D.P. Agrawal points out there is some confusion about the radio-carbon dates from Eran and nothing can be ascertained until a fuller report is obtained.[792]

At Nagda also iron appears in the period II levels. A continuity of the tradition of the chalcolithic in the Iron Age levels at this site indicates that iron made an early appearance here.[793] A substantial iron assemblage is reported form Nagda including double-edged daggers, axe-sockets, knives, arrowheads, spear-heads and sickles.[794] N.R. Banerjee, places the Iron Age level at Nagda II at C 750 B.C., on grounds of archaeological evidence.[795] However, Dilip K. Chakraborti states that since the chalcolithic phase in Central India ends around C 1300 B.C., the iron-bearing level in this region would fall around the 1000 B.C. at least, if not earlier still.[796]

PAINTED GREY WARE CULTURE :

In the Gangetic Doab, the earliest occurrence of the metal iron is noted at Hastinapur and Atranjikhera. At the former site, lumps of iron-ore and slags were met within the upper-most levels of the period II. we must note that the inhabitants of this occupational level were still using mainly copper tools and the period was characterised by the Painted Grey Ware.[797] The presence of iron-ore and slag may indicate local smelting of the metal at this site. During a later excavation at the site (1964) finished iron objects like pins, nails, knife-blades, etc. have been recovered from the middle level of the PGW phase.[798] Thus, it is clear that the people at Hastinapur were smelting and using iron in daily life along with copper. The radio-carbon date from Hastinapur fall between 570 and 335 B.C.[799]

However, as against this late date from Hastinapur, we have an indication that the iron was introduced much earlier in the PGW sites in the Doab, from the dating available from Atranjikhera, viz., — 1025 ± 100 B.C. from the Period III (PGW) at the site.[800] Here we may also mention that, as R.C. Gaur points out, the radio-carbon dates from Hastinapur are not reliable as all the samples were found to be badly contaminated.[801] At Atranjikhera the use of iron was common throughout the PGW Period. A total of one hundred and thirty-five iron objects as well as seven pieces of iron slag and fourteen indeterminate objects have been reported from the site. The Lower Phase of the PGW Period (III) yielded two shafts, two nails, a borer, two indeterminate objects and a lump of iron slag. Besides these, a number of iron objects occur in the Middle Phase, Viz., seven arrowheads, three spear-heads, five shafts, ten clamps, four nails, two bars or rods, two hooks, two borer, four chisels, one knife, one bangle, two lumps of slag and three indeterminate objects.[802] It should be noted here that the radio-carbon date of 1025 ± 110 B.C. comes from this Middle Phase of the PGW context.[803] So that, it appears

that by the end of the eleventh century B.C., the people at Atranjikhera were already using a variety of iron implements and weapons. The presence of iron slag points out that iron was smelted at the site. R. C. Gaur points out that the introduction iron at Atranjikhera may stratigraphically be placed in the 12th century B.C.[804]

The main source of iron for the smiths at this site was perhaps the iron-bearing region extending from south of Agra to Gwalior. The excavator also suggests that the PGW black-smiths were perhaps smelting iron in the following manner : the ore was put along with fuel in an open circular or oval-shaped pit-like furnace, and then subjected to high temperature raised with the help of a leather bellow. This process would have allowed the metallic content to run out in fluid form and deposit at the bottom of the furnace. The extracted metal, thereafter, would have been collected and forged repeatedly and hammered out to be in proper shape for preparing the desired objects.[805] We may note here that we have already described a similar primitive mode of operation at the beginning of this section.

The analysis of the iron objects from Atrankikhera by O.P. Agrawal reveal that the iron used by the PGW people here was not of meteoric origin. The metallographic examination of some iron objects showed that they were first made of wrought iron and were later on carburized by some technique so that the zone nearest to the surface turned into carbide. O.P. Agrawal points out that this happens when the iron object is kept on charcoal bed for a long time at a high temperature.[806]

Jakhera, another site in the Doab region, has yielded evidence for iron from Period IIA onwards, which includes arrowheads and a complete sickle-blade. From Period IIB, the mature PGW Phase, the iron objects begin to occur in large numbers.[807] About forty-one objects have been recovered from this phase, including, arrowheads, spearheads, celts, chisels, sickles, daggers, axe perhaps a

plough-share and large numbers of chunks of iron slags.[808]

The early occurrence of iron in the Black and Red Ware phase at Jakhera (IIA) and at Noh in Rajasthan as well as appearance of iron in chalcolithic phase at some sites in West Bengal can be compared to the data at Ahar. This might put back the first appearance of iron, if not a properly practised iron technology, to an earlier date. We may discern here an incipient technology of using a new metal taking shape under the aegis of an old metal-handling tradition. In fact, instead of forever coming up with the theory of diffusion of iron technology from West Asia our researches could point to a indigenously growing technique from the wombs of an old tradition. Apart from specific handling know-how, the basic craft of metal handling were the same. It only required more experimentations to seccessfully smelt iron. Further studies are required to substantiate the above hypothesise.

Alamgirpur saw the introduction of iron in the Period II levels where one encounters the occurrences of certain ceramic types in the red Ware found at Hastinapur and Rupar in association with the NBP Ware, a plain grey Ware, as well as a low percentage of the PGW as compared to the plain grey ware and red ware. O.P. Tandon, therefore, places this assemblage at Alamgirpur to a late phase of this PGW culture.[809] He holds that a date of C 800 B.C. is appropriate for the earliest known use of iron in the PGW context.[810] The iron objects from this Period II at Alamgirpur include a spear-head, arrow-heads and a few nails and pins.[811]

At Kausambi small fragments and shapeless bits of iron were discovered as early as the third of the four structural periods within the first period of occupation (Period I_3-I_4) on the site which was clearly pre-Painted Grey Ware in the interpretation of the excavator.[812] The structural period I_3 may be dated round about from C 1025 B.C. to 955 B.C., on archaeological grounds.[813] The PGW phase (Period II) at

Kausambi witnessed the frequent occurrence of arrow-heads and spear-heads.[814] H.C. Bharadwaj, however, places the Kausambi I phase around C 845 B.C. along with Sonpur IA and Chirand IA. He places Kausambi II around C 765 B.C. along with Rajghat IA, Sonpur IB, Chirand IB, etc.[815]

The above evidences show that the emergence of Iron Age in the PGW context in the Ganges-Yamuna Doab would more surely begin around C 800 B.C., except for a few early occurances at Atranjikhera and perhaps Kausambi. It was at about the same time that iron begins to occur in the Black-and-Red Ware context in eastern Uttar Pradesh and Bihar.

EASTERN INDIA :

Further east, in West Bengal, we observe the early appearance of iron at Mahisdal in Birbhum district. Here the Period II levels, characterised by the Black-and-Red Ware painted in white as well as in black and a number of other wares, has yielded iron objects, such as arrow-heads, spear-heads, chisels and nails. A large quantity of iron-ore and slag at this site testify to the acquisition of the knowledge of iron metallurgy by the local people in this context.[816]

At Pandu Rajar Dhibi in Burdwan Distric, iron objects occur in the Period III level. The excavator states that iron was known and probably smelted at this site side by side with the use of copper and microliths in Period III in a chronological horizon around C 1000 B.C.[817] However, we may note that a radio-carbon sample from the cemetery level of the Chalcolithic Period (II) gives the date of C 1012 ± 120 B.C.[818] Hence the iron-bearing Period III may date a little later after the C 1000 B.C. The iron objects comprise a long celt and an arrow-head with a tang[819] as well as a spear head and some blades.[820] We may note that the Black-and-Red Ware continues to occur in this Period. Most interesting, however, is the finding of a short iron sword of 'cut-and-thrust' type with tapering point and sturdy hilt from Trench no. 7A, along with some terracotta heads and a vase

of pinkish buff colour. Some clay seals with the uncommon motif of a doubleaxe at one end are very curious evidences.[821] The excavator suggests that the extensive conflagration noted in the so-called citadel area within the main mound at Pandu Rajar Dhibi and the occurrence of the few iron tools may indicate the influx of a new people if not plainly an intrusion of culture.[822] Lastly, we must mention that a round token of gold which seems to have been hammered on the edge, has also been recovered from Period III.[823] Iron occurs in the Period III level at Bharatpur, period II levels at Bahiri and Hattigra and Period I at Mangalkot. The mean date for these sequences can be placed approximately around 750 B.C.[824] Among these sites Bahiri in Birbhum district have yielded evidences indicating large scale smelting at the upper levels.[825]

The above survey of the earliest occurrences of iron in the Indian sub-continent would suggest that iron tentatively made its appearance in this part of the world around the 1000 B.C. The iron and iron metallurgy first occured in some regions only, especially in the north-west of the subcontinent and perhaps in the Karnataka, Rajasthan, the Doab region and eastern India. About some of the sites mentioned above the datings are nor ascertained and often confusing and hence, the introduction of iron in Central India, for example, cannot be securely dated. Radio-carbon dates are, moreover, not always available. However, from the above study it appears that iron made a more steady appearence around and after the C 700 B.C. This is especially true of the PGW sited in the Doab region.

Now, our study of the iron repertoire at the above sites reveal that a number of implements and weapons were being used by these early iron users, viz., the spear head, arrow-head, knife and celt among the weapons, and chisels, borers, pins and nails among the tools and implements. The sickles from Atranjikhera, Jakhera and Nagda and the axe from Noh may indicate the use of the metal in agricultural jobs, albeit only in a small way. However, in most cases, the

iron-assemblage is so small that they would not merit the designation of full fledged Iron-Age context in these early days. At most of these sites copper and stonetool industries continue to exist.

As we shall note, it is around the C 700-600 B.C. that iron industry truly begins to creep into the common market. At some of the above sites, we come across evidences for local smelting of iron which goes to the credit of the early blacksmiths for, as we have already noted above, the process required a great deal of knowledge, experience and skill. The early smiths had probably begun to use bellows and blast-furnaces also. However, this was only the beginning and there was no great evidence for all round socio-economic or cultural changes as yet. Around C 700-600 B.C., iron began to penetrate into newer regions hand in hand with the PGW culture and the Megaliths and subsequently the NBP Ware Phase.

It was around the seventh century B. C. that the Megalithic Culture flourished in the Vidarbha region in Maharashtra. The excavations at Megalithic sites in and around Nagpur, Takalghat-Khapa, Naikund, Kaundinyapur, Junapani etc., indicate that the megalith-builders with the black-and-red pottery were inhabiting these regions around this time.

The twin sites of Takalghat and Khapa, on either bank of the river Krishna, the former a habitation site, the latter a site of stone circles or Megalithic graves, give evidence of an iron using people. The range of iron objects encountered in the stone circles comprised spearheads, daggers, barbed arrow-heads, swords, spikes, etc. among the weapons. The more interesting are the tools, viz., double-edged adzes, nail-parer cum-tooth picks, and flat axes, with ring band cross fasteners.[826] Other categories of iron artifacts recovered at Takalghat and Khapa include ladles, chisels, spikes, tang pieces and miscellaneous objects.[827]

The doubleedged adzes are made out of thin sheets of iron cut to a double-concave outline, very thin in the middle and with broad convex cutting edges. It is possible that these edges were used for cutting skins. The nail parers are a rod of iron with one end tapering to a point and the other bevelled to a sharp, broad cutting edge. Some of the pieces have cabled bodies. The flat axes are rectangular with convex and broad cutting edge, flat top, sides slightly flaring towards the broad convex cutting edge and the body equipped with cross-band ring fasteners. These have been reported from several megalithic sites in the south as also at Takalghat itself. Most interesting is the complete cauldron of iron with rivetted circular holds also encountered in one of the Stone circles at these sites. We may note here that a number of copper objects like fish-hooks, bangles and bells with iron tongues have also been recovered at the stone circles and the habitation site at Takalghat-Khapa.[828] Carbon samples from the habitational deposits give radio-carbon dates of 615 + 105 B. C. and 555 + 100 B. C.[829]

Very interesting evidence come from Naikund, a site 42 km from Nagpur, on the left bank of the river Pench. Here a habitational mound was surrounded by megalithic stone circles. Near the habitation site of at Naikund the remains of a workshop comprising a furnace and its components was noted. The furnace was built of small curved bricks with a cylindrical terracotta pipe or tuyers through which air was perhaps bellowed into the closed furnace to raise the temperature for smelting or reducing iron from the ore. Iron ore was also located in the form of rubble in a nala or drain which was about one km. south-east of the smelting site. It is clear, therefore, that the megalithic smelters used a local source of iron ore. Further investigations by Dr Gogte of the Deccan college have shown that the megalithic smelters used about 10 to 12 kg. of iron ore for a single smelting operation, producing 3 to 4.2 kg. of pure iron.[830] The radio-carbon dates are 672 ± 115 B. C. and 655 ± 100 B. C.[831] The

Vidarbha megalithic folks were using copper ornaments for horses which probably indicate a ritualistic tradition corresponding to the Vedic Aśvamedha. S. B. Deo points out that it is in the fashioning of these copper ornaments for horses that the megalithic craftsmen excelled.[832] Iron spears, daggers, arrow-heads etc. have also come from the other megalithic sites like Kaundinyapur and Junapani.[833]

At a later date, evidence for a regular iron industry is obtained at Ujjain in Madhya Pradesh. The evidence of smelting is provided by enormous deposits of iron slag, unsmelted or partially smolten iron ore, lumps of a crystalline material identified as calcite or aragonite, and quantities of a whitish powder, presumably lime, the result of smelting in close connection in the fillings of a canal or channel of Period II. According to N. R. Banerjee, this evidence ranges in date from C 500 to 200 B.C.[834] Although dating from a later time than our scope, we deem it proper to mention here that long antecedants to this iron industry of Ujjain must have been present from C 600 B.C. onwards, featuring iron-extraction, smelting and forging in more and more skilful manner. The iron bearing sequence at the Malwa culture sites of Nagda and Eran have been suggested to have belonged to a date around C 1300 B.C. approximately by D. K. Chakrabarty.[835] Taking into consideration the late dates at Ujjain and Besnagar we require to be a bit more cautious. While it is true that at Ujjain and Besnagar life began at the iron age only and that at Nagda[836] and Eran[837] the Malwa culture disappears around C 1400 B.C., we may put the iron sequence at the last two sites earlier than 500 B.C. The appearance of iron technology can be placed anytime between 1300 and 500 B.C., with perhaps more stress on a date around 700-600 B.C. as evidence from the neighbouring regions suggest.

In south India also, Palavoy in the Anantapur District, Andhra Pradesh, has yielded some interesting evidences in this line. Excavations here revealed that the site underwent

two burnings. The slaggy layers yielded Iron Age pottery along with two iron objects, a nail and a ring and pieces of iron slag. In addition, the vitrified ash lumps of these layers presented the appearance of a row of columnar structures with dome-shaped roofs. The excavators, Ansari and Rami Reddy thought that these structure served as kilns or ovens for iron-smelting.[840] We have already noted that iron had been introduced earlier in south India in the megalithic context at Hallur and in northern Deccan, in Maharashtra in the Vidarbha megalithic context. Andhra Pradesh, lying midway, may have witnessed the introduction of iron somewhere around the sixth century B.C. and the people here were perhaps taking up iron smelting in a regular manner. Excavation at T. Narsipur, in Mysore District Karnataka confirms that a fullfledged iron-using culture with the megalithic Black-and-Red ware had emerged in the region in Period II.[841]

We may also note that at Brahmagiri the Iron Age Culture is represented sandwiched between the layers of the neolithic chalcolithic and early historic Andhra Cultures.[842] There is not even a single layer consisting purely of the iron age components, but these components increase in number from the lower to the middle level and begin to decrease in the upper phase. This situation is also noted at sites like Maski and Sanganakallu as also Hallur. Iron implements like arrowheads, nails or pins, daggers, swords and rods occur at one or all of these sites, indicating the development of the iron age culture along with the continuation of the older elements.[843] S. Nagaraju and B. K. Gururaja Rao point out that the early iron age in south India may have covered the time-span of about six centuries from C 1000 B.C. to the commencement of the early historic period about 400 B.C.[844] whereas, D. P. Agrawal and S. Kusumgar places the southern megaliths between C 600 and C 100 B.C. generally.[845]

Meanwhile, iron and iron metallurgy was spreading fast in northern India. But before going on to these evidences,

we would like to discuss the data from the Cairn-burial sites first. As we have mentioned above, the date of the Cairn-burial sites is a matter of much controversy. It was D. H. Gordon[846] who had associated the Cairn-burials with the problem of the beginning of iron in India and linked these sites in the Baluchistan with Sialk VIB. He held the date of 1200-1000 B.C. for Sialk VIB and put the beginning of the Baluchistan Cairn-burials around C 900 B.C.

However, later, scholars like Leslie Alcock.[847] B. R. Subramanyam[848] and D. K. Chakrabarti[849] all argue against this early date for the Cairn burial sites on the basis of the available data. They all attribute these Cairn-burial sites a date in the early historical period. As we have already mentioned earlier, D. K. Chakrabarti feels that the Baluchistan Cairn-burials could not be put earlier than the first century B.C. on the basis of existing data.[850]

Nevertheless, we would like to look into the assemblages at some of these sites to see how far the adoption of iron had spread in this context. At the Cairn-burial site of Moghul Ghundai ten iron arrow-heads and one iron spearhead have been recovered. From Zangian a badly rusted and broken large iron sword blade and another smaller and similarly damaged weapon of war and some fragments of iron have been recovered. From Nasirabad has come some small pieces of iron implements. At Gatti the Cairns have yielded fragments of an iron pot and some decomposed iron. From Jiwanri some scraps of iron, an iron fish-hook and some fragments of small iron implements have been recovered. The cairns at Damba-Koh have yielded a lump of oxide of iron, very thin iron vessels and two iron javelines. However, a Parthian coin at Damba-Koh clearly gives this site a historical date.[851]

However, the list of iron objects do not show that the use of this metal had become widespread at these Cairn-burial sites. First, compared to the number of cairns at these numerous sites, the above list is extremely insignificant.

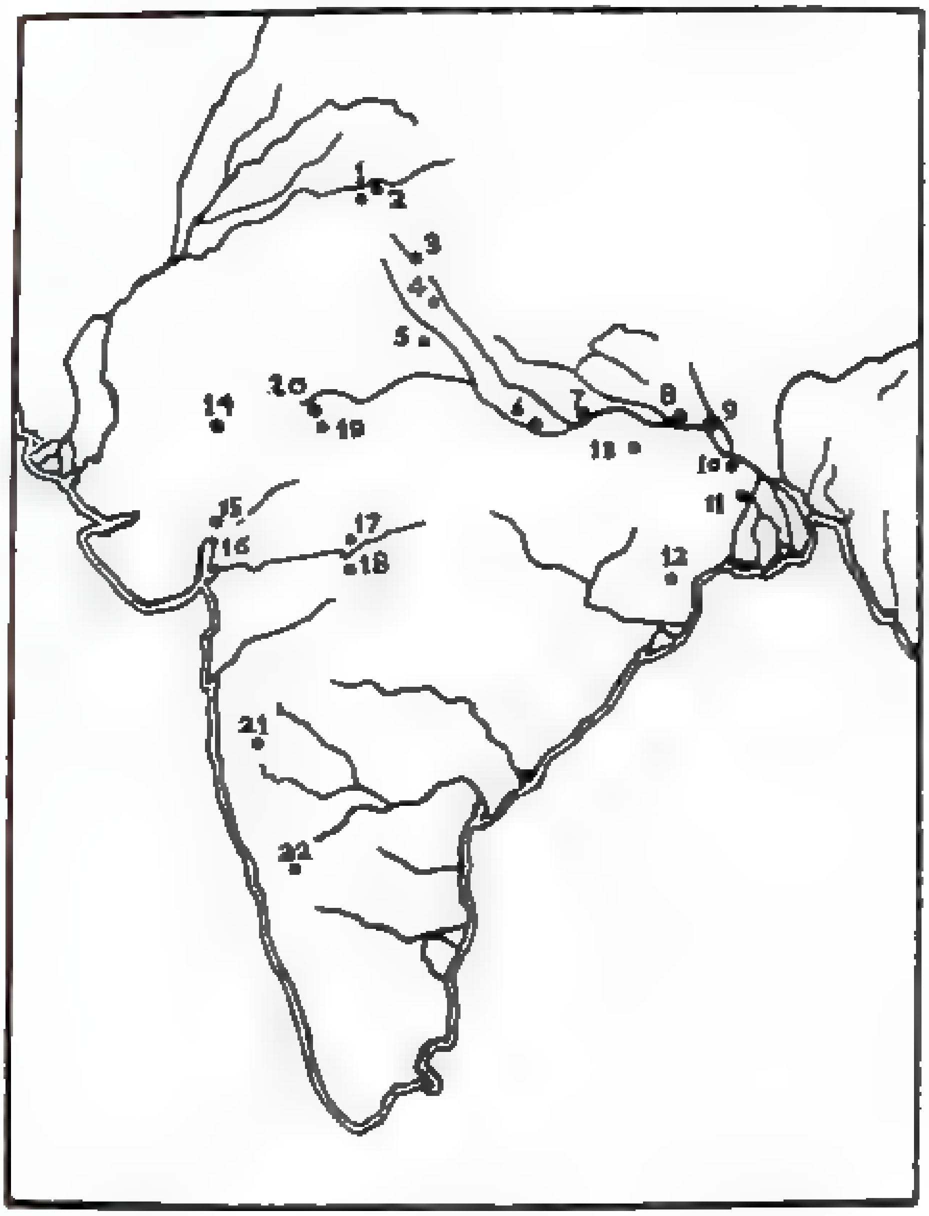
Moreover, most of the objects are weapons etc. and the implements are so fragmentary that they have not been identified in the reports. And if the historical date for these sites is accepted then the significance of the Cairn-burial sites in the early Iron Age context diminishes considerably.

In the Punjab, the site at Rupar in District Ambala witnessed emergence of the Iron Age context in the Period III which may be dated to C 600-200 B.C. the iron objects comprise nails, hooks, bars, spikes with socket, handled knives, daggers, sickles and spear-heads. This period was characterised by the NBP Ware.[852] Autha, in District Gurgaon, Punjab, however, witnessed the introduction of iron in a PGW context. The iron occurs mostly in lumps.[853]

In the Western India, we have the evidences for the occurrence of iron at Dhatva in Gujarat. This site has also yielded very interesting evidences of iron-smelting. Dhatva or Dhatwa in the Tapi Valley in the Surat District yielded iron objects, heaps of metallurgical tap slag and pieces of iron ore. These materials were associated with crude Black-and-Red Ware. The evidence may belong to a date in the mid-centuries of the first millennium B.C. Among the iron objects recovered were a hoe with a flat underside, upturned butt and pointed end ; and fragments of chisels ; knives and nails.[854] It appears that the black smiths at the site were manufacturing some utility objects.

The available evidence shows that the smiths were exploiting the local ore and fuel resources. At Dhatwa wood charcoal was probably used as fuel for there are no sources of coal or peat close to the site.[855] Excavations revealed the presence of both the limonite and haematite ores in the layers 3,2,1 and on the surface at the site. Hegde mentions that R. B. Foote and Edwin Pascoe had noted the presence of trap outcrops weathering into laterite in the Tapi Valley. They had also noted a laterite bed near the bottom of the Tapi river section.[856] Subsequently explorations near Dhatwa by R. N. Mehta and K. T. M. Hegde revealed that the basal

DISTIBUTION OF RICE IN ANCIENT INDIA



MAP- XVI

KEY

1 RUPAR	8 CHIRAND	15 LOTHAL
2 KANGRA	9 ORIYUP	16 RANGPUR
3 HASTINAPUR	10 MAHISDAL	17 MAHESHWAR
4 ATRANJIKHERA	11 PANDU RAJAR DHIBI	18 NAVDATOLI
5 NOH		19 GARH KALIKA, UJJAIN
6 KAUSAMBI	12 BAIDIPUR	20 NAGDA
7 RAJGHAT	13 RAJGIR	21 INAMGAON
	14 AHAR	22 HALLUR

laterite bed was located within 2 km of the Dhatwa mound on the south bank of the Tapi river. The nearest surface laterite formation was found to lie across the river, within 4 km of the site. However, there are no indications of mining in the basal laterite formation. On the other hand pieces of limonite in the surface laterite were found lying scattered around and could be easily collected. It is quite possible that ancient iron smiths at Dhatwa were exploiting this surface limonite.[857]

Analysis of the limonite and haematite lumps at Dhatwa indicate that the limonite ore was roasted at the site to convert it into haematite before smelting.[858] However, the Dhatwa smiths had not yet mastered the technique of efficient smelting. For, the analysis of the slags revealed that much of the iron in the ore was lost in the slag. It also indicates that smelting was being carried out at the minimum temperature of reduction, about 1100°C to 1200°C and also that the ore was not fluxed.[859] Two metal samples cut from the hoe and the other cut from a fragment of a knife show that the iron produced at Dhatwa was remarkably pure.[860] The metallographic study of the hoe revealed that it underwent three metallurgical stages. Firstly, the red, hot bloom after being extracted was forged into flat strips on an anvil near an open hearth. In this process the surfaces of the strips were carburised and case-hardened. Secondly, a number of such strips were joined laterally, one by one, by forgewelding. Finally, the whole built-up mass of iron was further forged to shape it into a hoe.[861]

Thus the available evidence noted above shows that the Dhatwa iron smelters, exploiting the local ore and fuel resources roasted the limonite ore first and then smelted it mixed together with wood—charcoal in a small clay—lined crucible—shaped shaft furnaces in which air was driven by bellows. The small bloom that came out was forged on an anvil in front of the hearth. In the forging process, the adhering slab separated out and simultaneously the surface of the metal was carburised and case — hardened. The bloom

was beaten into a thin strips of metal and these strips were later forge-welded together to build up a thick mass of iron which was further forged to shape it into the desired object.[862]

It is probable that similar smelting and forging operations, exploiting the local ores, were being carried out at a number of places throughout the Indian subcontinent at least by the sixth century B.C., which would account for the proliferate use of iron in everyday life around this time. Before passing on to the Vedic evidences we may briefly survey the situation in the Doab Zone.

In the eastern Doab region we also note that iron occurred for the first time at a number of sites in a context characterised by the Black-and-Red Ware. This is noted at Rajghat IA,[863] Sonpur IB,[864] Chirand IB[865] and Prahladpur IA.[866] The radio-carbon dates available for these periods from Sonpur (635 ± 110) and Chirand (765 ± 100)[867] would indicate that iron was introduced in the eastern Doab region around the eighth and seventh centuries B.C.

At Allahapur in District Meerut, a variety of iron objects occur in the PGW context in Phase IB. However, we also note the occurrence of NBP Ware in this context.[868] Therefore the iron yielding level at Allahapur is perhaps of a later date than those at Atranjikhera or Hastinapur. At Ahichchhatra, in Dist. Bareilly, the use of metals, both copper and iron, is clearly evident from the Period I onwards, which was characterised mainly by the PGW.[869] At Sonpur in the Gaya District, Bihar, iron nails and blades appeared in the NBP Ware Phase. Notably, the Black-and-Red Ware also continued to occur in this period. The beginning of the Period III may be placed about 600 B.C.[870] At Buxar in District Shahabad, the Period II levels yielded iron implements. These levels are characterised by the NBP Ware.[871] At Vaisali also the first occurrence of iron is associated with the NBP Ware and the Black-and-Red Ware. The Period IA may be dated between C 500-200 B. C.[872] At Chirand, in Bihar from Period II (NBP Ware Phase) iron blades begin to occur in more numbers.[873]

At the sites that have already witnessed the appearance of iron in the PGW context in the Doab region, the NBP Ware Phase saw an increasing number of iron objects of every shape and use. At Atranjikhera, for example, the Period IV, designated the NBP Ware Cultural Phase, saw a profused use of iron in everyday life. About three hundred and thirty-eight objects of iron were recovered, including twelve slag pieces and twelve broken pieces of bar. The agricultural tools make their appearance for the first time and about sixteen new items were introduced.[874] R. C. Gaur has categorised the objects into four sections, viz., the weapons, the agricultural tools, craft tools and household objects. Among the first group occur arrow-heads among which a few new types were noted, spear heads and shafts.[875] Agricultural tools like sickles, spud, plough-share, hoe and digger (khurpi) indicate that iron was being profusely used in agricultural operations at least around the 600 B.C.[876] The craft tools comprise tongs, clamps, ring-fastener, socketed clamp staple, bolt, plumb bob, nails, hooks, borers, chopping knife, chopper, pipe and Scraper, Chisels of a few new shapes also occur.[877] The household objects such as the axes, knives, bangles, lid and disc complete the list and amply prove the adoption of iron in all spheres of life. We may note here that numerous copper objects of tool and household types also occur [879] and four gold pieces, among which are two foils, have also been recovered.[880]

Rajghat in Varanasi, as we have already seen yielded a few iron objects in Period IA (C 800-600 B.C.), characterised by the plain black-and-red Ware, Black slipped Ware, Plain Grey Ware, etc.[881] The Period IB (C 600-400 B. C.), characterised by the NBP Ware, saw the profuse use of iron. The objects include arrowheads, knives, nails and shapeless bits.[882]

Examinations of the Rajghat iron objects and slags recovered from Period IB (C 600-400 B.C.) levels show that meteoric iron was not used.[883] The iron of these samples is slag bearing wrought iron which could be welded and forged.

However, this iron would not harden much on cooling.[884] Some of these objects might have been carburized during forging in charcoal fire. The presence of small amount of iron carbide at the grain boundaries shows that carburization or case hardening was coming into vogue during the NBP phase.[885] However, from the composition of slag, we may infer that no flux was used for smelting iron.[886] It is also probable that though a temperature of about 1180°C (sufficient for the slags to reach liquidation), was obtained, yet the presence of large amount of slag inclusions suggests that this temperature could not be maintained for long to remove the slags completely.[887] The metallographic studies reveal the micro-structures which show that metal has been forged (banded structures) and worked. The iron objects could have been forged stage by stage from a bloom, to a bar, then followed the processes of thinning, pointing, folding and forge-welding. Bharadwaj points out that the iron bloom produced at Rajghat required furnaces which could reach a temperature of about 1180°C. However, forging, forge-welding etc. required a still higher temperature.[889] The Rajghat iron might have been obtained from the Bihar resources.[890] A lot of fuel must have been consumed in the process. However, iron was definitely a cheaper metal by these days as the people rapidly began to realise that it was present in great abundance in the region. We note a similarity in the metallurgical process adopted by the black-smiths at both Dhatwa and Rajghat. It would not be wrong to assume that by the sixth century B.C. a more or less common mode of metal working had evolved throughout cur region.

The above survey also reveasls that by this time, around 600 B.C. iron as a metal had been ushered into the economy and was serving the various strata of the society in their various jobs. And although there were some basic difficulties involved with the operations, the ready availability of the metal overcame most of the obstacles to the growth of the iron industry. In fact this ready availability of large deposits of iron ores in our country and the quick tapping of these

resources by the people had a great deal to do with the rapid pace gained in economy around C 600-400 B.C. The region of Bihar with its abundant supply of iron became a focal point in that development.

VII

EVIDENCES FROM THE VEDIC LITERATURE

The *Ṛg Veda* has repeatedly referred to the term *'ayas'* in various contexts, which definitely means some kind of metal. However, there is a lot of controversy around the exact connotation of this term. Monier Williams translated *Ayas* as iron, metal or iron weapon, gold and steel.[891] Gordon Childe on the other had held that the term referred to copper.[892] Later M. N. Banerjee pointed out that since the *Ṛg Veda* refers to three metals distinctly, viz., *hiraṇya*, *rajata* and *ayas*, the last would definitely mean iron.[893]

In the first book of the *Ṛg Veda*, the fifty-second hymn mentions the term in connection with Indra who is said to hold in his arms the *Vajram ayasam*[894] or the metal thunderbolt. This correlation between thunderbolt (electricity) and metal would indicate that the metal in question was as shining as the electricity noticed in the sky. The notion of power is also linked up here.

In another instance also we note the same conception as to the object denoted by th Rg Vedic people as *ayas*. This reference is also made in connection with *Indra*, the victorious and powerful Lord who is described as made of ayas, fierce against the strong, and fettered the wily *Sushna* in bonds.[895] R. T. H. Griffith has translated the phrase here as 'the iron one'.[896]

In another hymn a reference is made to wild boars with tusks of *ayas*. An interesting reference is made to columns of *ayas*, translated by Griffth as iron, which upheld the domination established by *Mitra-Varuṇa*. These pillars are also said to be adorned with gold ornamentations.[898] More interesting is the reference in a passage thus : *Agni*, like

archer, fain to shoot, sets his arrow and whets his splendour like the edge of *ayas* (metal or iron) or *ayaso dhārā*.[899] Geldner has translated *ayaso dhārā* as a blade of iron which is sharp as a flame.[900]

However, clear references to iron are perhaps made in the *Vājasaneyi Saṃhitā* and the *Atharva Veda*. The former mentions the six metals, viz., *hiranyam, ayah, Śyāmam, loham, sīsam, trapu*.[901] It seems *śyāma* would be iron because its colour is black and *lohāyas* appears to have been copper. The *Atharva Veda* classifies *ayas* into two varieties, namely *śyāma* and *lohita*,[902] meaning iron and copper, respectively.

N. R. Banerjee points out that *sutrakāra Mahīdhara* held that in *ayas* of the *Yajur Veda*, *ayas* stood as a general term for metals which included iron. To distinguish the latter further, the use of term *Kālāyas* was made, which is said to have been used alongside copper for making all objects.[903]

Thus, it is most likely that the term *ayas* was generally applied to all metals in the *Rg Vedic* times. Later on (after C 1000 B. C.) distinctive names were applied to the different metals known to the people. Whether this fact means that the *Rg Vedic* people did not know of iron altogether or whether it was due to a negligence on the part of the authors of the *Ṛg Veda* who failed to make clearly distinct references to different metals, cannot be ascertained. However, judging from the archaeological evidences noted above, it may be more probable that the Rg Vedic smiths were not yet familiar with iron around the 1500-1200 N.C. time-range to which the *Ṛg Veda* has been assigned.

However, it is certain from the above references in the *Ṛg Veda* that even if they did not know the use of iron they were evidently familiar with a hard, bright, sharp metal, perhaps copper or copper-bronze, which they definitely distinguished from gold, *hiraṇya*, which is very often referred to in the *Ṛg Veda*.[904]

The value of gold is amply emphasised in the hymn which praises *Indra*, Lord of a hundred powers,[905] who has

a car of gold,[906] and later in another passage in the same hymn — the Aśvins are described as wealthly in horses, kine and gold.[907] However, we come across a curious passage in the *Ṛg Veda* : 'The loftly Heroes cast their spears and weapons bright with gleaming gold ....'[908] The hymn is dedicated to the *Maruts* who are 'Loftly Heroes' in the passage. However, it is quite unlikely that spears and weapons of gold were in existence. Here is a case of either fantasy or that the metal of the spears and weapons shone like gold and may have been made of copper-bronze which gives out a bright sheen.

In another passage we get a description of warriors (here the *Maruts*), fully armed and dressed for war, viz.. 'Lances are on your shoulders, anklets on your feet, gold chains are on your breasts, gems, *Maruts*, on your car'.[909] It is quite obvious that the lances in question were made of metal perhaps copper or bronze less likely, iron. Gold and gems may have adorned the high-class warriors. It is likely that the Rg Vedic folks obtained fluvial gold from rivers. The *Ṛg Veda* refers to the river Sindhu as *hiraṇyānī* and *hiranyavartni*.[910]

The *Ṛg Veda* contains only one reference to silver (rajata) which means white and is used for qualifying a horse which is white in colour.[911] It seems that the Rg Vedic people hardly used the metal. It was not easily available and archaeological evidences for silver are also rare in our context, barring a few sites like Harappa and Mohenjo-daro, Mature Harappan settlements and Gungeria Copper-Hoard assemblage. The *Ṛg Veda* does not mention *trapu* or tin. Thus, it appears that in the *Rg Vedic* context the people were mainly using copper or copper-bronze and gold. The use of iron is not very certain.

As to the processes of metallurgy known to the Rg Vedic smiths, various passages refer to the smelter. One such passage has been rendered in the following manner : 'they threw the stones (ores) in the fire (flames) fanned with both the hands'.[912] As N. R. Banerjee points out, this gives

a crude picture of a very rudimentary smelting operation.[913] *Rg Veda* makes several clear references to the act of smelting and one such passage gives a clear understanding of the basic conception of smelting of ore, i.e., purification of the metal. The passage states that the gods doing holy acts smelt like ore their human generation.[914] N. R. Banerjee also states that in this passage the purification of the human life is compared to the purification of metal by smelting *ayas* which was practised by the smelters.[915] A further clear reference is found in the tenth book which states that all beings have been produced by the gods with blast and smelting dhamantaḥ like a smith.[916] Griffith further explains the phrase 'like a smith' — as a blacksmith blows up his fire and melts metal.[917]

In another passage a reference is made to *Viśvakarmā*, the creator who welded heaven and earth together with his arms fanning the flame in which the matter is smelted.[918] But, by far the most interesting, elaborate and clear reference to the operation of smelting metal is made in a passage in the ninth book of *Ṛg Veda*.[919] Griffith translates the passage thus : "The smith with ripe and seasoned plants, with feathers of the birds of the air, with stones, and with enkindled flames, seeks him, who has a store of gold. Flow *Indu*, flow for *Indra*'s sake".[920] Wilson translated it thus : "With dried plants (are arrows made) with the feathers of birds, with glistening stones, the smith seeks a man who has gold : flow Indra for Indra".[921] Moreover, Griffith mentions that *Sāyana* has explained it thus - with glistening stones to form the heads of the arrows.[922]

It is evident from the above passages that here we have a clear reference to the smelting of metal for arrowheads by throwing ores (stones) into fire and fanning up the flames to raise the temperature in the crude furnace. Griffith also further explains the phrase – "who hath a store of gold" - as one who will be able to pay well for the arrow which the artisan makes for him.[923] Thus there is no doubt about the value accorded to metal objects in the Rg Vedic context.

S. D. Singh points out that the word '*dhmā*' in connection with smelting and smelters (*Karmāra ivadhamat* in Rv, 10. 72. 2 and 10.81.3) seems to have been derived from the sound of the bellows.[924] The *Ṛg Veda* makes several references to the smelter or smith.[925](*dhmatṛn*).

The *Ṛg Veda* mentions a number of tools, weapons and even utensils made of metal, perhaps, copper, bronze and, less likely, iron. These are *asi* (sword), *Svadhiti* (axe), *Kshura* (razor), *Varman* (armour), *āvudha, ishu bāna* (arrow), paraśu (axe or hatchet), *dhanus* (bow), *śalya* (spear), *śṛnga, Khadge* (curved axe or sword) etc. Moreover, in Rv, 5.30.15 we get a reference to a pitcher made of metal for containing milk.

In later Vedic texts, as we have seen, we get clearer and distinct references to the different metals known to the Later Vedic people. We also get the references to the different activities in connection with the metal industry. For example, the *Atharva Veda* credits *Agni* with having the knowledge of treasures deposited in the earth,[926] and the gods digging out them for their worshippers.[927] These may be references to mining. Moreover, *Śatapatha Brāhmaṇa* indicates that the ore of gold was extracted from the stone.[928] The *Atharva Veda* also states that as ore is freed from impurities by smelting (*dhamantaḥ*), so too a person should purify his humanity to shine like smelted ore.[929]

There are probable reference to mixing of metals or perhaps alloying. It is said that gold was used for softening silver, tin was softened by means of silver, lead by means of tin and *lohā* by means of lead.[930] The *Śatapatha Brāhmaṇa* informs that repeated smelting made a metal luminous.[931] The art of smelting was confined to the *dhmatṛṇs*, the smelters or smiths, as in the Rg Vedic days. There are numerous references to the smelting of metal.[932] The *Maitri Upaniṣhad* mentions a lump of iron "overcome by fire and beaten by workmen", passing into a different form.[933]

The Later Vedic people had also categorised the different metals they used in grades according to values. Gold was

considered as of the highest value, silver of intermediate and copper of a lower value.[934] It has also been put forward that as a horse signifies nobility among the animals, gold occupies the most exalted status among the metals.[935] Gold, silver and copper have been compared with the *brāhmaṇs*, *Ksatriya* and *Vaiśya*, respectively.[936] The metals were already being evaluated perhaps in terms of exchange—value and were definitely valuable personal possessions of the people. For prayers were offered to the Gods for bestowing them on the worshippers.[937]

We have noted that gold and copper and/or copper-bronze had already been adopted full-fledged in the Rg Vedic society as useful and valuable metals. We have also noted that the first distinct references to iron were made in the Later Vedic texts. Besides the *Vājasaneyi Saṃhitā* and the *Atharva Veda* (noted above) the *Chāndogya Upaniṣhad* also speaks of *Kārsnāyas* and *Krshāyasa*[938] which certainly mean iron, as also it is mentioned in the *Aitareya Araṇyaka*[939] and the *Maitrāyana Brāhmaṇa Upaniṣhad*.[940] The *Śatapatha Brāhmaṇa* exhorts that in the *Aśvamedha* sacrifice, all the sacrificial animals except the horse, should be slaughtered with knives made of iron because they were used by the peasantry.[941] This indicates that the metal had begun to be widely used in the later Vedic times by the common people.

We may also note here that clear references to bronze *(Kāmsa)* was made in the Later Vedic literature only. In these it is stated that vessles of *Kāmsa* were used for holding butter and *madhuparka* in certain sacrifices.[942] Tin *(trapu)* has also been mentioned only in the later Vedic texts.[943]

Thus, by the end of the Later Vedic phase (around the sixth century B.C.), we have the Vedic people possessing a full-fledged metal industry in which gold, copper, bronze, iron and also tin were being worked. The evaluation of the metals, noted above, makes it quite evident that the metals had acquired the status of valuable possessions. This is quite natural in a society that was fast developing the concept of

private property, a political order that was heading towards dominations, dominions, a greater concentration of power, and a vigorous exchange economy.

The metals evidently formed an important element in this exchange-economy, be it based on barter or monetary exchange as the reference in the *Ṛg Veda* (where the maker of the metal arrowheads seeks a wealthy purchaser) shows. We may note here that Kautilya emphasises, a little later, that one who owns the mines owns the world. The *Arthasāstra* also presents the picture of a society where mining was subjected to state control,[944] indicating the realisation of the importance of the metals and minerals and the necessity of having the political control of the king over these sources to wield and maintain political domination. The realisation may have had its roots in the Vedic days and even earlier.

This was the value-side of the story of the metals in the later Vedic context. As far as utility is concerned, there is no doubt about the fact that metals were being adopted in daily life and jobs because people were becoming more and more conscious of their utility as compared to implements made of stone, wood and bone, and utensils of clay in some cases.

Not only were the objects of metal hardy, sturdy, lasting and could produce sharp, heavy, thick implements as demanded by the people but also the metals could be shaped into desired shapes as they are more malleable, once melted. The melting quality of the metal, once the required temperature was obtained, gave a greater edge to metal over other raw materials for making weapons, implements or utensils. We may note here that the later Vedic people (inhabiting the region from Punjab to western Uttar Pradesh and filtering into eastern Uttar Pradesh and Bihar in the later Vedic Phase) were not using iron so commonly around C 800 B.C. The reference in the *Yajur Veda* asking for the gift of iron, indicates that the metal was as yet precious and scarce.[945] However, by the period of the *Śatapatha*

Brāhmaṇa iron seems to have become a fairly well-known metal as the various references from this text noted above indicate. One para in this text puts it that the use of an earthen pot was preferable to a golden, copper or even an iron vessel. The reason advanced for this preference, the para explains, was that the handle of an iron vessel, on heating, would become too hot to be lifted.[946] Thus iron vessels with handles were definitely in common use by this time, and we may note that in the early days of the metal industries it is the manufacture of utensils and their use by the common people that comes almost at the end when the metal has been already adopted and much used in the sphere of weapons and tools. Hence by the time of the *Śatapatha Brāhmaṇa* which is commonly assigned to a date around C 700 B.C., iron seems to have been widely adopted. Vibha Tripathy has also put forward the same opinion.[947] The Archaeological data also indicate such a possibility. On the whole, by the end of our period it became the most widely used metal and the iron industry perhaps also began to play a great role in the drama of politico-economic dominations that was being staged in the northern India around the sixth-fifth centuries B.C.

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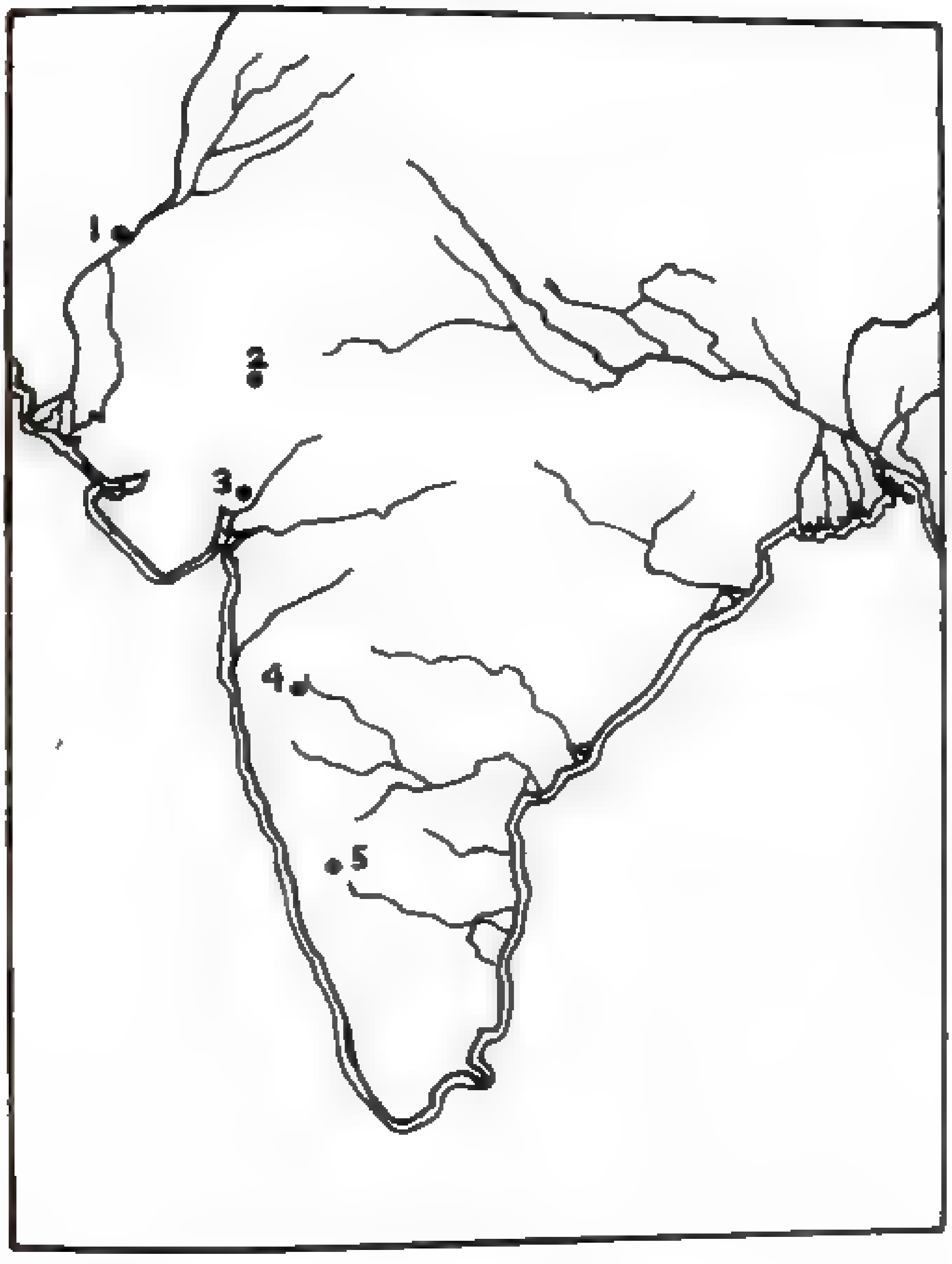
DISTRIBUTION OF MILLETS IN ANCIENT INDIA



KEY
1 MOHENJO-DARO (JOWAR)
2 AHAR JOWAR (AND BAJRA)
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MAP-XVII

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EPILOGUE

The story does not end. A panaroma of social progress is illuminated which is so complex in compostion that one is breathtaken at the unique blend of texture that one encounters when looking at the history of the Indian subcontinent in the earliest days. Technological advancement in our context did not mean a one-time 'revolution' that altered the life-styles of societies overnight or even over a century or two in a uniform pattern. The 'Neolithic Revolution' of Gordon Childe[1] is as yet a much less grasped subject than the Industrial Revolution of the modern times could ever be. "In little more than 50 years the increasing substitution of machinery for human effort .....had wrought the Industrial Revolution." "The process had been developing slowly for more than three centuries, but towards the close of the 18th century it had suddenly accelarated,"[2] heralding the 'Age or Progress', as portrayed by John Bagnell Bury.[3] Sir Denis Brogan remarked on the contention of Bury that progress was not an inevitable law of nature, but simply an idea made by man, that it shocked the contemporary society in putting forth this new idea of a human effort changing society.[4]

When we look aeons of time back at the fledgling human societies in the small, habitable niches in the wide area denoted the Indian subcontinent, we find a very slow, almost imperceptible movement being made by human beings at eking out a better existence in the lap of nature. Thus began the first human efforts at mastering techniques to manipulate nature. The progress towards a better, more secure way of life was not made everywhere at the same time, not made in the same direction either, even, not made

at all in some regions for a long time to come. It took immeasurable time, energy and cognition at macro levels to make some headway in generating artificial production of food — the primary requirement of human societies. In our context we found the earliest discernible examples around the sixth millennium B.C. The process of adoption and adaptation of conceived technology and natural elements began in a few contexts while others were slow in entering the thresholds of this drama. The variabilities of the drama lent it great colour and attracted a lot of hypotheses. The present work makes an effort to look into almost all the acts and operatives in this drama as exhaustively as possible in the given state of research.

The techniques involved in domesticating wild species of animals with an eye to the requirements of human society and the natural feasibility of such operations called for definitive participation. The adaptation of groups of people to the operations of animal husbandry altered social patterns at many levels. The secured reserve of food in the form of animal protein set off demographic progress. It also brought about an awareness of the natural resources among the human societies. In our context we have noted a few developments which marked such awareness and resultant developments and adjustments made in technology and economy which often left a mark on social life. We have, for example, noted a shift from sheep and goat—based husbandry to a predominantly cattle husbandry at some sites through phases as at Mehgarh and Tarakai Qila in Baluchistan. This shift, as we have discussed, was most probably linked up with a shift made in the direction of plant domestication and the higher stage of agriculture. This shift is also associated often with a gradual migration from foot hills to river plains at macro levels. This was noted generally throughout Baluchistan in the neolithic context.

At a later stage of agricultural economy we find finally about three different variables operating within the broad

spectrum of the occupation and economy of animal husbandry. The first variable is that *where we* find animal husbandry associated with agriculture both running parallel in a symbiotic relationship. This we find at or rather near fully sedentary settlements as noted in the Hakra Valley, at many Baluchi sites and in the Gujarat in an *early* Harappan — Mature Harappan context. The second variable is where we find animal husbandry fully absorbed within agricultural farming where the peasant was actually a farmer keeping a ready cattle stock. In most instances this called for a mixed-stock farming. The findings at major Harappan sites indicate such an economy as at most rural sites in the southern and central Indian neolithic contexts. The last and the most interesting variable is that where our evidences indicate the operation of full-scale, specialised pastoralism with associated features of nomadism or seasonal migration. This is evident at many of the neolithic ash-mound sites in South India and even at some Gujarat sites like Nesadi.

These major variables lay before us the magnitude of technical adoptions undertaken by pastoralists and herders where the chief concerns were the choice of the right species of animal to be domesticated, the ecological feasibilities, the biological requirements of the species concerned as well as the requirements of the human society as regards food and physical labour. This brings us to the requirement of animal labour in production operation. At a developing stage of agricultural economy this was an important criterion as we have seen already.

But coming back to nomadic pastoralism and cattle herding there is another very important aspect that needs to be covered. We have discussed in this work the probabilities of nomadic cattle keepers operating as transporters throughout a wide network of routes linking Karnataka, Rajasthan, Gujarat, Sind or alternately, Karnataka, Rajasthan, Haryana and the Punjab. More exploratory work in this direction may provide us with interesting clues to the

problems of distribution and collection of raw materials, non-perishable food items throughout the Harappan cultural context and outside that context and in subsequent times. The matter of training and harnessing pack animals to carts was a revolutionising operation. Not only was it the wheeled vehicle which should be a matter to be taken up for serious study in early contexts but also the involvement of domestic animals in transport which entailed a great deal of technical expertise on the part of the trainer, a matter which is to be noted. These aspects of the technology of animal husbandry is often not referred to at all. It is also necessary to establish a spatial correlation between settled sites and those sites which have been identified as temporary camps of nomadic herdsmen to form ideas about the relationship if any, which existed possibly between villages and pastoral folks in a region. The present state of our knowledge do indicate the possibility of such relationships having existed among the neolithic cultures in the Shorapur[6] and the Raichur doabs.[7]

The question of ecological variants as major factors in the development of economic patterns becomes glaring when we look into evidences that come from the north eastern hills of the subcontinent. What we find here is an absence of any major data hinting at the stage of economy in these regions at any give time within our context. However, the probability of jhum cultivation is highly indicated. Recently, Shereen Ratnagar has pointed out the importance of this technique in the conditions pertaining to the region.[8] In regions of heavy rainfall leading to soil erosion, the slash and burn method and the shifting cultivation which follow are ideally suited as a unique technique. At other more favourable conditions the mastering of cultivation techniques required no less expertise. The farmers at Mehrgarh had made wise choices regarding crops, considered ecological permeability for cultivation and have gone on to develop variants of a crop species all in the neolithic context. Adaptation of wild rice for cultivation also took effect at the

site of koldihwa in the Allahabad almost as early as the Mehrgarh experience. However, the dearth of archaeological evidences as well as the absence of scientific reports on findings do not allow for a continued story of domesticatioon of plants in the Ganges-Vindhya region.

The myth that the Harappans used few implements for cultivation of plants and plough was unknown to them has been shattered. The Pre-Harappans at Kalibangan were ploughing their cultivation fields as were the Harappans at Shortughai. The terracotta models of plough from Mohenjodaro and Banawali should be considered as evidences. However, the question that has been raised time and again in connection with agricultural techniques practised by Harappans is that concerning irrigation and, on a broader basis, the man-land relationship. The matter has been discussed at some length in this work. The probability of well irrigation[9] in view of the volume of production achieved by Harappan farmers in the limited scope of water supply offered by the major rivers cannot be overlooked at all. In fact this probability is well substantiated at the site Allahadino in the Karachi region. We have discussed the findings of W.A. Fairservis at the site.[10] The practice of storing water in reservoirs for irrigation purposes has also been gone into. But, there is a lot of gap left and one needs to take into consideration dry farming in winter at suitable places. More researches are necessary to locate the irrigation techniques practised by such high productive cultures as the Harappan. But within the macrocosm of the Harappan Culture were small variables which could be identified by the different techniques each such context adopted for production of food. The basic distinction between large metropolitan settlements and rural sites is easily discernible. But what is required is more extensive excavations in the vicinity of metropolises to locate their rural counterparts. The Hakra Ware culture and the Early and Mature Harappan Cultures in the Hakra valley provide a significant addition to

our knowledge regarding the lay-out of village sites. But the establishment of links between major sites and satellites in a constellation of land-use pattern could benefit such studies as this. Thus, the work faced a lot of obstacles in the nature non availability of archaeological data.

The limited growth of agriculture at the Central Indian and Deccan chalcolithic contexts is again a consequence of major ecological restrictions in the way of extensive cultivation. The meandering river valleys at upper courses of rivers Ghod, Narmada, Pravara did not offer extensive alluvial tracts for cultivation. The rocky base beneath the Deccan table-land limited the scope for well irrigation. The level of ground water was not very high either. However, we need more data on the hydrography of these regions to understand the conditions better. Works similar to those of L. S. Leshnik, J. C. Gardin[12] and Marcia Fentress[13] would be extremely welcome in the circumstances. Lastly, we may stress on the evolution of a crop pattern on a regional basis in our context which reflects the perfection of ancient farmers in adapting different species to different ecological contexts and also the nurturing of newer genus under older species. By the times when the Vedic literature was being composed the various nomenclature of the different genus within each species had evolved. The same is true for animal husbandry. In both these technologies of production the quantity, quality and adaptability were the main features of species selection and the Vedic terminoloty reflect these features. Among rice we have *Aśudhānya*, *Mahāvṛhi* to denote different varieties according to quality and quantity, among horses there were *Aśurāśva* and *Mahāsaḥya*, and so on.

The technology of metallurgy which evolved once the production of food was under way poses several problems and issues before us at the end of this study. The one with which we should begin is this very problem of the relationship between surplus food production and the development of

metal technology. The existence of the metal smith working in the Jodhpura-Ganeshwar complex and the Copper Hoards pose serious problems in assuming the growth of surplus food production prior to that of metal handling. We have approached the problem in our work but a conclusion eludes us. At best we can try to establish certain links with rural, food growing communities in the vicinity of the sites concerned. The location of Jodhpura sites near old-worked mines in some instances along with the absence of evidence for sufficient food economy at the sites could lead to several hypotheses as to the status of the metal workers who lived near mines vis-a-vis settled village sites or even the major Harappan sites to which they supplied metals.

The relationship between the supplier and the recipient cultures might have been a part of a feudatorial system. Alternately, the metal smiths could actually have been an offshoot of the local farming community engaged in a trade nexus with higher cultures. But in the latter case we do not discern a balance in the relationship. Yet, one may point out that to a twentieth century observer of ancient cultures the tools for understanding the workings of societies of old are inadequate. Present day notions may not grasp the complexity of such relationships.

In studying the evolution of metallurgy in our context the main problem that faces one is the one concerning the origin of the technology of metals. We have referred to the oft-repeated theory suggesting a diffusion of metal technology from Iran and West Asia. However, our findings concerning early instances of metal handling in our context set us seriously thinking on counter arguments. Taken together, the evidences for metal works at Mehrgarh, Jodhpura complex, pre Harappan Kalibangan, even traditions at Nal and the newly discovered site of Kunal in Rajasthan (all mentioned in the work) do provide a millennia or two of metal working legacy for the simths of the Mature Harappan days. Diffusion of some special techniques like alloying with tin for bronze

might have occurred. Bronze alloying with tin occurs before C. 2500 B.C, at sites like Troy I, Thermi I, Alishar I and Tepe Gawra VIII.[14] However, alloying with lead for bronze and even with tin occurred early in the sub continent as our study revealed. In fact as Dennis Heskel and Lamberg-Karlovsky point out,[15] the few tin bronze pieces found at the site of Tepe Yahya in Iran around the third millennium B.C. were probably the result of trade/exchange rather than the beginning of a new technological trend in south-east Iran. They cite the fact that tin-bronze was being extensively used in the contemporary Indus Valley civilization and in the Nal cultural context in preceding times. At Nal sites evidences suggest local smelting and metal working. All this is highly suggestive of an indigenous devlopment. In all the contexts where metals were evidently being locally worked, both in chalcolithic and iron bearing contexts, the local smiths had a great role to play at every stage of the development of the technology. The models for metal works were provided by stone and ceramic industries but the adaptation of these models in metal required a lot of expertise. The regional and cultural variations are reflected in tool typology. The example is provided by the Copper Hoards. The Copper Hoards by themselves are an enigma as yet not satisfactorily explained. Various links could be established which we have covered above. One hypothesis that could be put forward to explain the lack of cultural assemblages in connection with the Copper Hoards is that of itinerant smiths. We have discussed this issue. The matter cannot be finally put to rest but this thesis tries to pose valid questions as this to clear the debris of unreferred data. At the level of know-how, it was seen that metallurgy once mastered was not lost even under the volume of decay that set in after the Mature Harappan Phase. So far as the source of copper ore is concerned, Rajasthan is indicated as the most likely source within the subcontinent besides Afghanistan. The question of itinerant smiths carrying ores and finished items and circulating

across the frontiers of different cultural contexts has been raised and discussed in some details. The likelihood of such operations being linked up with the Copper Hoards as well as chalcolithic complexes in the Rajasthan as that of Jodhpura has been suggested. However, scuh theories are only at a hypothetical level without more detailed working in the regions involved. The question of trade and distribution of metals is intimately linked up with the development of metallurgy. We have tried to locate the possible sources. The more recent findings of Harappan presence in the regions of Oman and Bahrain may be added to the given data.[18] However, these sources were elementary in their significance.

So far as the introduction of iron is concerned. the theories connecting the Rg Vedic Aryans and the Painted Grey Ware Culture have been looked into. Our findings, however, point to a possible alternative of an indigenous origin of iron handling techniques. The discovery of iron in the chalcolithic phase at some sites like Ahar in Rajasthan. Bharatpur and Mangalkot in West Bengal and Nagda and Eran in Central India may be taken into consideration. The gradual transition from copper works to iron works is not an unlikely occurrence. In fact at some sites the copper artifacts do show a high ferrous content as from the Copper Hoard axe found at Hansi and Rewari, (P. Yule, 1989, The Copper Hoards of the Indian Subcontinent, Preliminaries for an interpretation, Mainz), from Atranjikhera Painted Grey Ware Level (R. C. Gaur, 1983, Excavations at Atranjikhera. Delhi), a few artifacts from Chandoli (S.B. Deo and Z. D. Ansari, 1965, Chalcolithic Chandoli, Poona). Besides, in most of the copper artifacts belonging to the Copper Hoards the ferrous content is noticeably present. The introduction of bellows and the achievement of a higher degree of temperature in a closed furnace were possibly a later day development in the post 700 B.C. times. Evidences from Jodhpura regarding iron smelting indicate the use of common crucible-shaped furnace in the early days of iron technology.

Once we come into the iron age, the availability of ores throughout the subcontinent resolved the issue of distribution which had restricted the use copper in the preceding period. Iron was popularised from 600 B.C. onwards since the time large scale penetration of the Middle Ganga Valley took place. This is best brought out by R.S. Sharma[17] when he discerns the use of heavy iron shares in ploughs by the Later vedic society as indicated by the Satapatha Brāhmana. The Bihar plateau with its abundant supply of iron running upto Orissa and West Bengal borders gave a tremendous impetus to the industry in the post sixth century B.C. era. The industry was not uniformly developing throughout the subcontinent. There were external factors like demographic growth, formation of political units and initiation of social institutions controlling the labor scene which guided its development. The Vedic literature reflect this growth of socio-political units where the land and its resources were cognitively brought under regulation.

In the context of creating a distribution nexus of food and metallic ores the regularisation of such distribution presupposes some kind of control generation.[18] This is true for the Harappan society as well as the burgeoning state society the glimpses of which we get from the Vedic texts. Such regularisation necessarily commanded a control not only over supplies but also over the conditions in which the techniques of production thrived. In the present work we have not gone deeply into the subject which requires a detailed study, however, we have referred to those features of the organisational pattern which could be discerned from our handling of the evidences for the production sectors under consideration.

In our survey of the data the most obvious factor that meets the eye is the plurality of patterns within the greater homogeneity of each cultural enclave. The homogeneity was probably often the result of a control system, hegemonic or otherwise.[19] The relationship between technological growth

and progress in economy was not a unilateral one but multidimensional. Similarly, the growth within the production sector (primary, secondary) itself took different dimensions under the varying ecological and social patterns. We have tried to look into these variations within our scope in order to locate the growth within technological know-how and economy. How far the available evidences for the period under review could substantiate these variations and how far the work has been successful in computing the data available is a question which has set the author time and again to re-evaluation from the standpoint of history. On this last question it may be offered that much remains to be done and much depends on further scientific examinations of data. At this stage of research we have just been able to draw a few guidelines in studying the progress of societies in our context. In drawing these guidelines we have never lost sight of the fact that progress was never unilinear or unidimensional nor could each cultural enclave be regarded as having been monolithic. The variations within societies, regions and within temporal contemporaneity would perhaps in the end provide answers to many questions.

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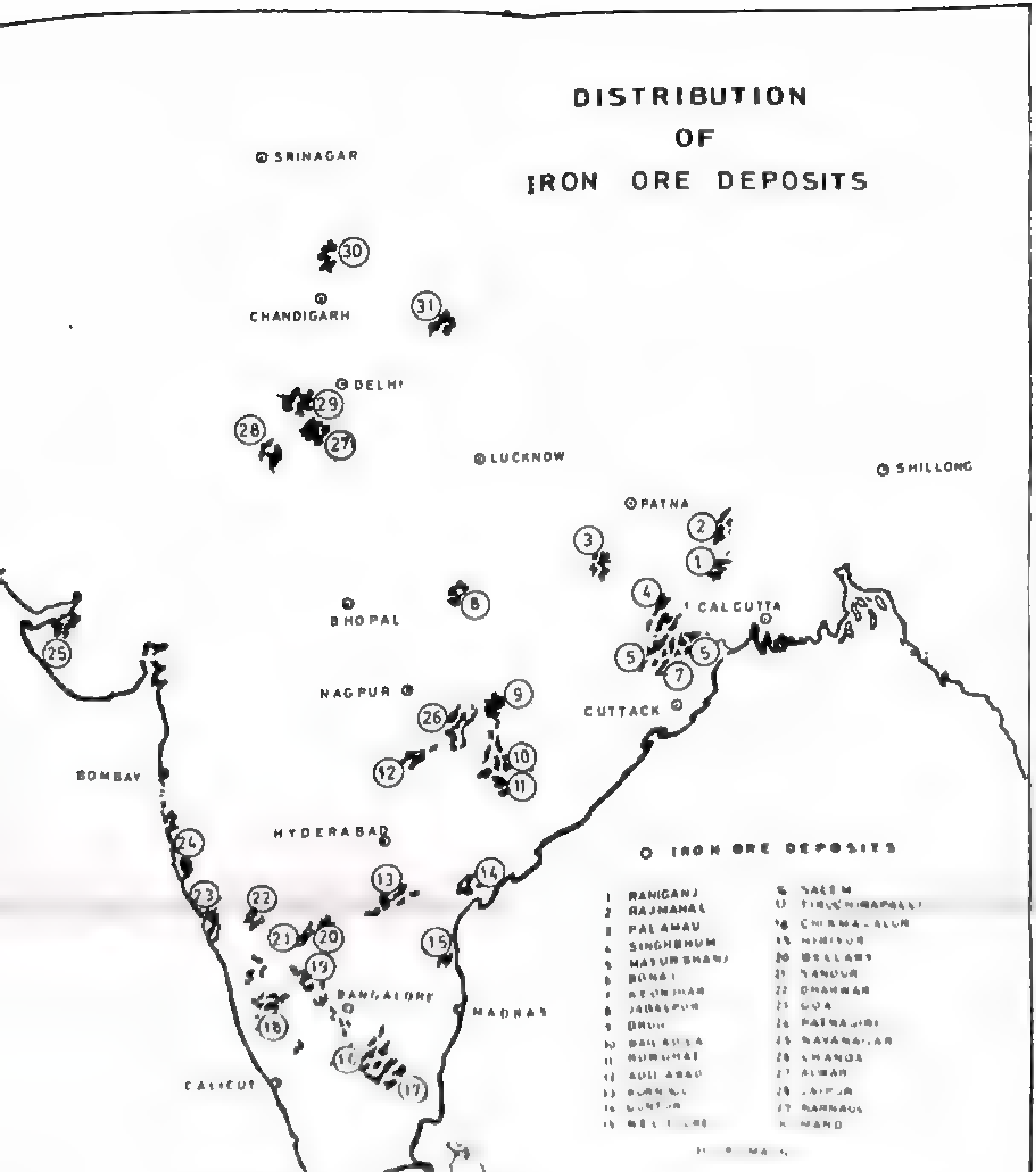
DISTRIBUTION
OF
IRON ORE DEPOSITS
SRINAGAR
CHANDIGARH
DELHI
LUCKNOW
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CUTTACK
BOMBAY
HYDERABAD
BANGALORE
MADRAS
CALICUT
TRIVANDRUM
IRON ORE DEPOSITS
1 RANIGANJ
2 RAJMAHAL
3 PALAMAU
4 SINGHBHUM
5 MAYURBHANJ
16 SALEM
23 GOA
31 MAND

MAP - XVIII

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TABLE — I
C^{14} DATES OF NEOLITHIC SITES

SITES	C^{14} Dates based on Halflife = 5730 years. In years B C.
Ghalighai	1608 ± 50 B.C.
	2355 ± 70 B.C.
	2422 ± 55 B.C.
	2376 ± 140 B.C.
Kili Ghul Mohammad	3470 ± 83 B.C.
	3690 ± 85 B.C.
	3510 ± 515 B.C.
Mehrgarh	5182 ± 80 B.C.
	5378 ± 290 B.C.
	6743 ± 250 B.C.
	7716 ± 120 B.C.
	11790 ± 120 B.C.
	(all dated uncalibrated)
Burzahom	1535 ± 110 B.C.
	1825 ± 100 B.C.
	1850 ± 125 B.C.
	2025 ± 350 B.C
	2100 ± 115 B.C.
	2225 ± 115 B.C.
	2375 ± 120 B.C.
Kodekal	2460 ± 105 B.C.
Utnur	2040 ± 115 B.C.
	2050 ± 115 B.C.
	2295 ± 155 B.C.
Tekkalkota	1540 ± 105 B.C.
	1610 ± 140 B.C.
	1615 ± 105 B.C.
	1780 ± 105 B.C.
Sangana Kallu	1550 ± 105 B.C.
	1585 ± 105 B.C.
	1590 ± 110 B.C.

TABLE — I

C14 DATES OF NEOLITHIC SITES

Palavoy	1540 ± 100 B.C.
	1965 ± 105 B.C.
Hallur	955 ± 100 B.C.[1]
	1105 ± 105 B.C.[1]
	11955 ± 100 B.C.
	1425 ± 110 B.C.
	1710 ± 105 B.C.
Paiyampalli	1360 ± 210 B.C.
	1485 ± 100 B.C.
	1725 ± 110 B.C.
T. Narsipur	1495 ± 110 B.C.
	1805 ± 110 B.C.
Chirand	1270 ± 105 B.C.
	1375 ± 100 B.C.
	1515 ± 155 B.C.
	1540 ± 110 B.C.
	1570 ± 115 B.C.
	1580 ± 180 B.C.
	1675 ± 140 B.C.
	1755 ± 155 B.C.
Koldihwa	6571 ± 210 B.C.
	5440 ± 240 B.C.
	4530 ± 185 B.C.

F.N. 1 Dates from the Neolithic-Megalithic overlap Phase at Hallur.

TABLE — II

C[14] DATES OF NEOLITHIC SITES

SITES	C^{14} Dates based on Halflife = 5730 years, In years B.C.
Amri	2665 ± 110 B.C. 2900 ± 115 B.C.
Balakot	3406 ± 137 B.C. 3334 ± 77 B.C. 3061 ± 82 B.C.
Damb Sadaat	2346 ± 82 B.C. 1400 ± 130 B.C. 2220 ± 410 B.C. 2550 ± 200 B.C.
	2320 ± 360 B.C. 2510 ± 70 B.C.
Gumla	2248 ± 74 B.C. 2382 ± 151 B.C.
Kalibangan	1765 ± 115 B.C. 2105 ± 105 B.C. 2225 ± 95 B.C. 2290 ± 120 B.C. 2370 ± 120 B.C.
Kot Diji	(2920-2940 B.C. - MASCA corrected dating) 2250 ± 140 B.C. 2330 ± 155 B.C. 2600 ± 145 B.C. 1800 ± 140 B.C.
	1865 ± 110 B.C.
Mindowari	1895 ± 115 B.C. 2065 ± 110 B.C.

TABLE — III

SUMMARY OF THE APPROXIMATE CHRONOLOGIES OF DIFFERENT CULTURES

Harappa Culture	C 2300 — 2000 B.C. (Nuclear Region) C 2200 — 1700 B.C. (Pheripheral Region)
Jodhpura Culture	C 2500 — 2000 B.C.
OCP Culture	C 2000 — 1500 B.C. (in the Doab)
Kayatha Culture	C 2000 — 1800 B.C.
Malwa Culture	C 1700 — 1400 B.C.
Jorwe Culture	C 1400 — 900 B.C.
PGW Culture	C 1000 — 300 B.C.[1]
NBP Culture	C 600 — 50 B.C.
Southern Megaliths	C 600 — 100 B.C.

F. N. 1. Taking into consideration the mean date for PGW at Atranjikhera.

TABLE — IV

NEOLITHIC AND PREHARAPPAN SITES IN AFGHANISTAN, BALUCHISTAN AND SIND AND THE CORRESPONDING WATER SYSTEMS

SITES	WATER SOURCES
Mundigak	Kushk-i-Nakhud Rud (a now-dry tributary of the Arghandab river)
Deh Morasi Ghundai	Dori river
Said Qala	Tamak river
Mehrgarh	Bolan river
Kili Ghul Mohammad	Hannah river
Rana Ghundai	Gomal river
Ajjira	Anjira river (a tributary of the Mula river)
Sur Jangal	Thal river
Balakot	Windar river
Tarakai Qila	Tochi river
Gumla	Gomal river
Amri	Indus river
Rehman Dheri	Gomal river
Kot Diji	Indus
Jalilpur	Confluence of the Ravi and Chenab
Sarai Khola	Northern reaches of the Indus proper
Banawali	Now-dry bed of the Sarasvati
Kalibangan	Now-dry bed of the Ghaggar or Sarasvati

TABLE — V

LOCATION OF SOME IMPORTANT NATURE HARAPPAN SITES OUTSIDE THE GREATER INDUS REGION

SITES	LOCATIONS
Shortughai	Plain of Shortughai at the confluence of the Kokcha river and the Amu Darya.
Harappa	Ancient confluence of the two nowdry streams of the Ravi in the Ravi valley.
Ropar	Sutlej Valley
Siswal	Drishadvati Valley
Mitathal	Alluvial tract between Kasaunti and Dohan rivers.
Rakhigarhi	Old Drishadvati bed
Lothal	Between the Bhogavo and Sabarmati rivers
Rangpur	On the Bhadar river
Alamgirpur	On the Hindon river

INDEX

Plate. 1

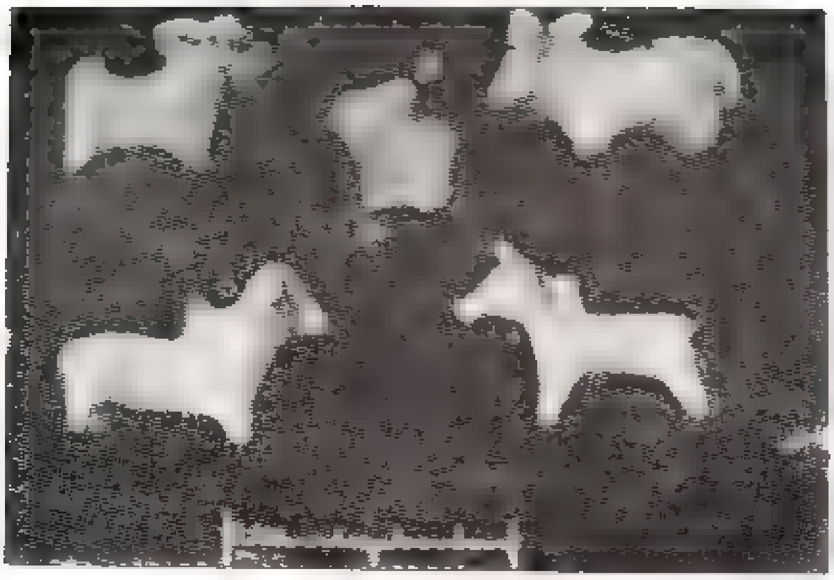


Fig. I : Terracotta Bull Figurines From Mature Harappan Period, Banawali.

Fig. II : Humped Bull Figurines and Model of A Plough, Hakra Valley Sites.

Courtesy : Harappan Civilization A Contemporary Perspective.

Plate. 2

Wheat Grains From Mohenjodaro and Chanhudaro

Courtesy : Harappan Civilization A Contemporary Perspective.

Plate. 3

Fig. I : Terracotta Model of a Plough, Banawali

Fig. II : Mohenjodaro Granary.

Courtesy : New Frontiers of Archaeology.

Plate. 4

Fig. I :

Plate. 4

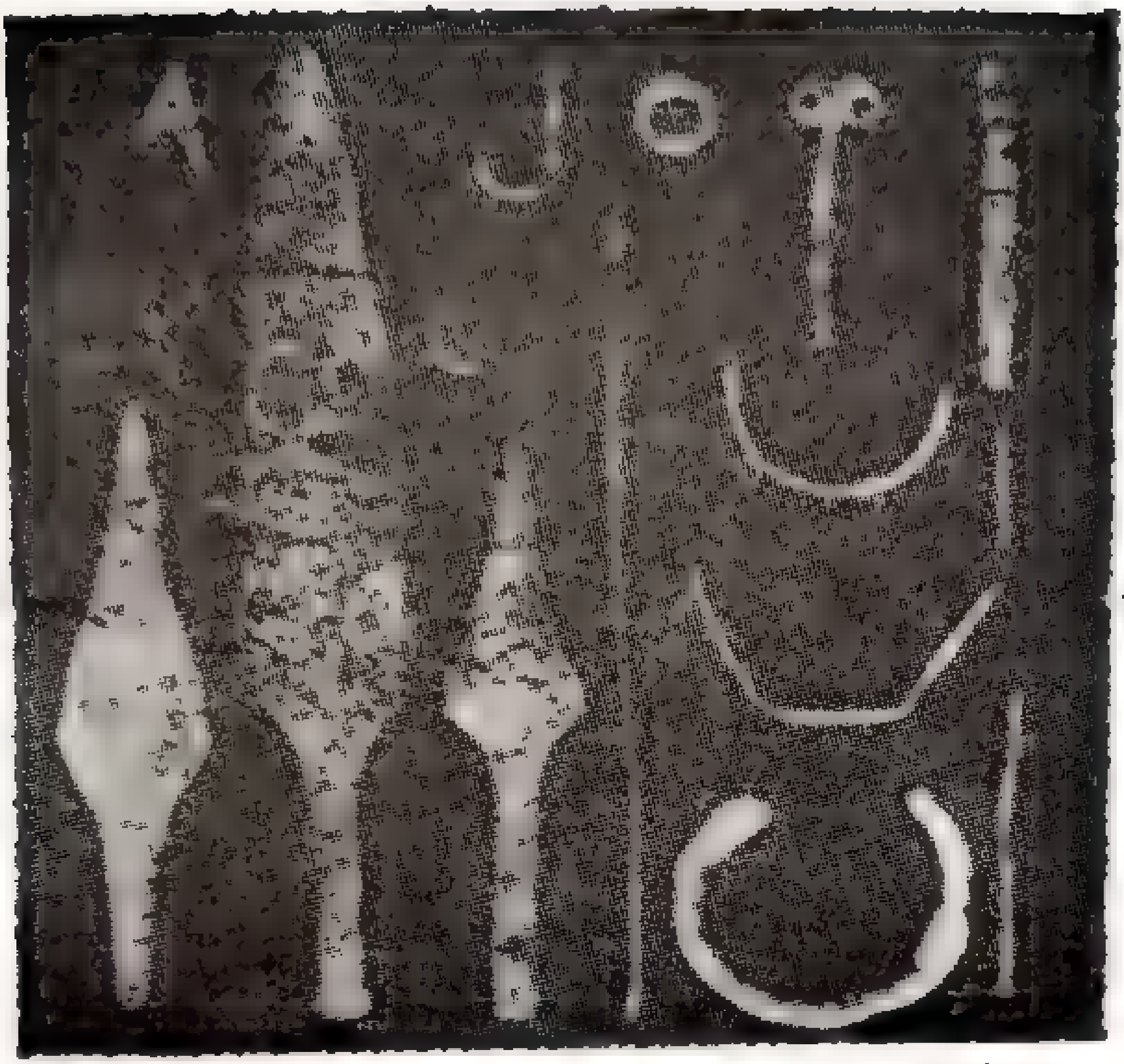


Fig II : Copper Implements, Harappan Period Banawali.

Courtesy : Harappan Civilization A Contemporary Perspective.

Plate. 5

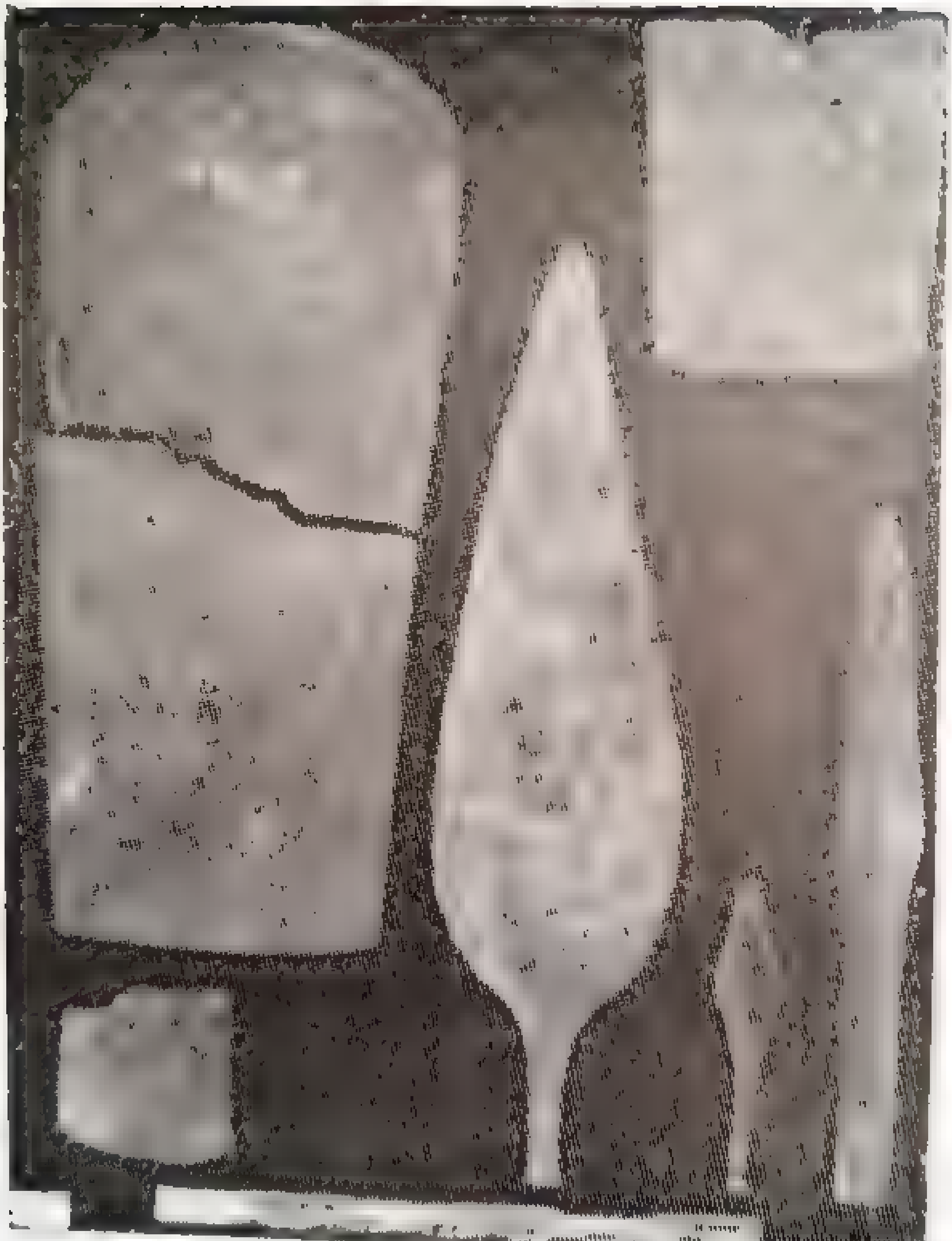


Fig. 1

Plate. 5

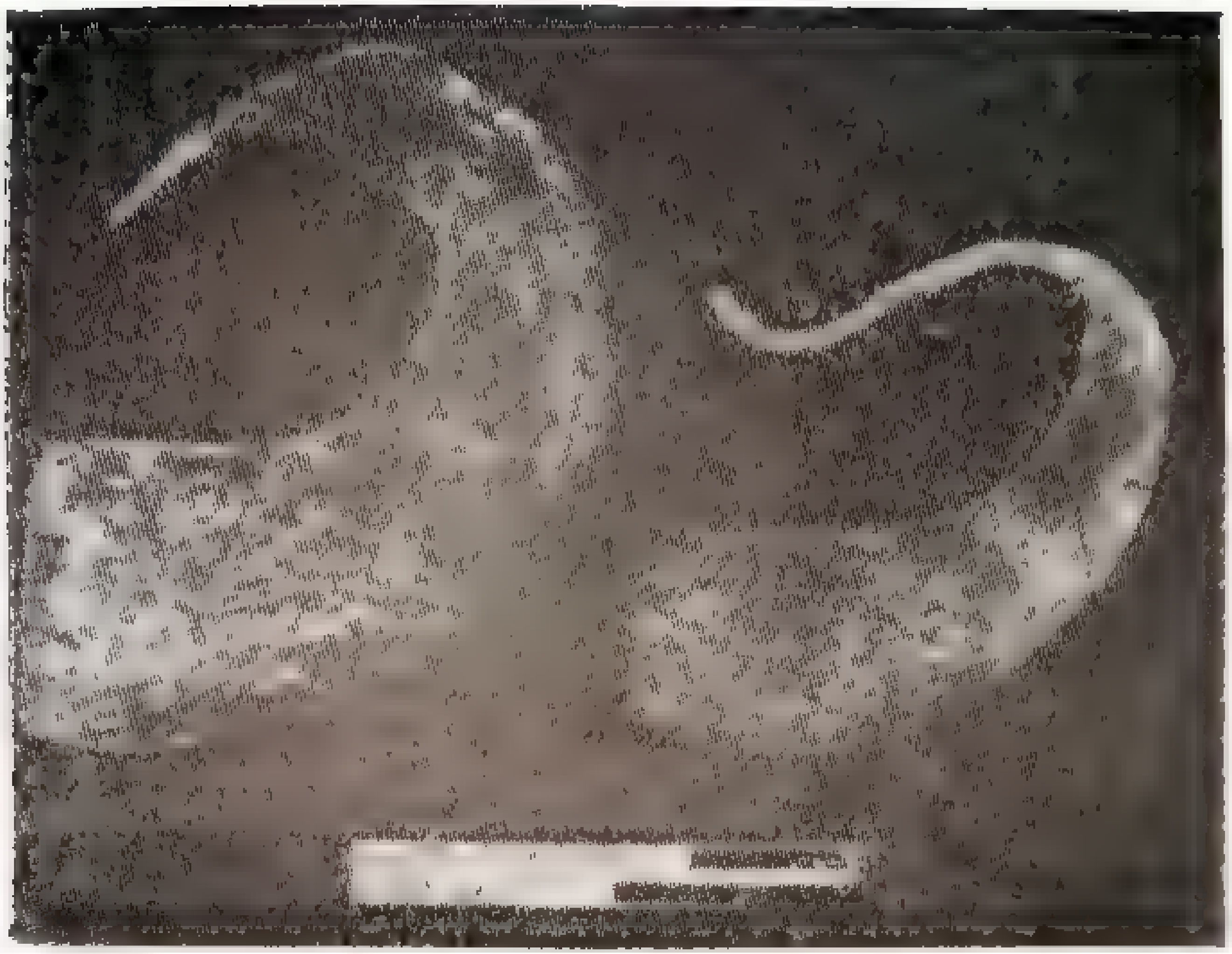
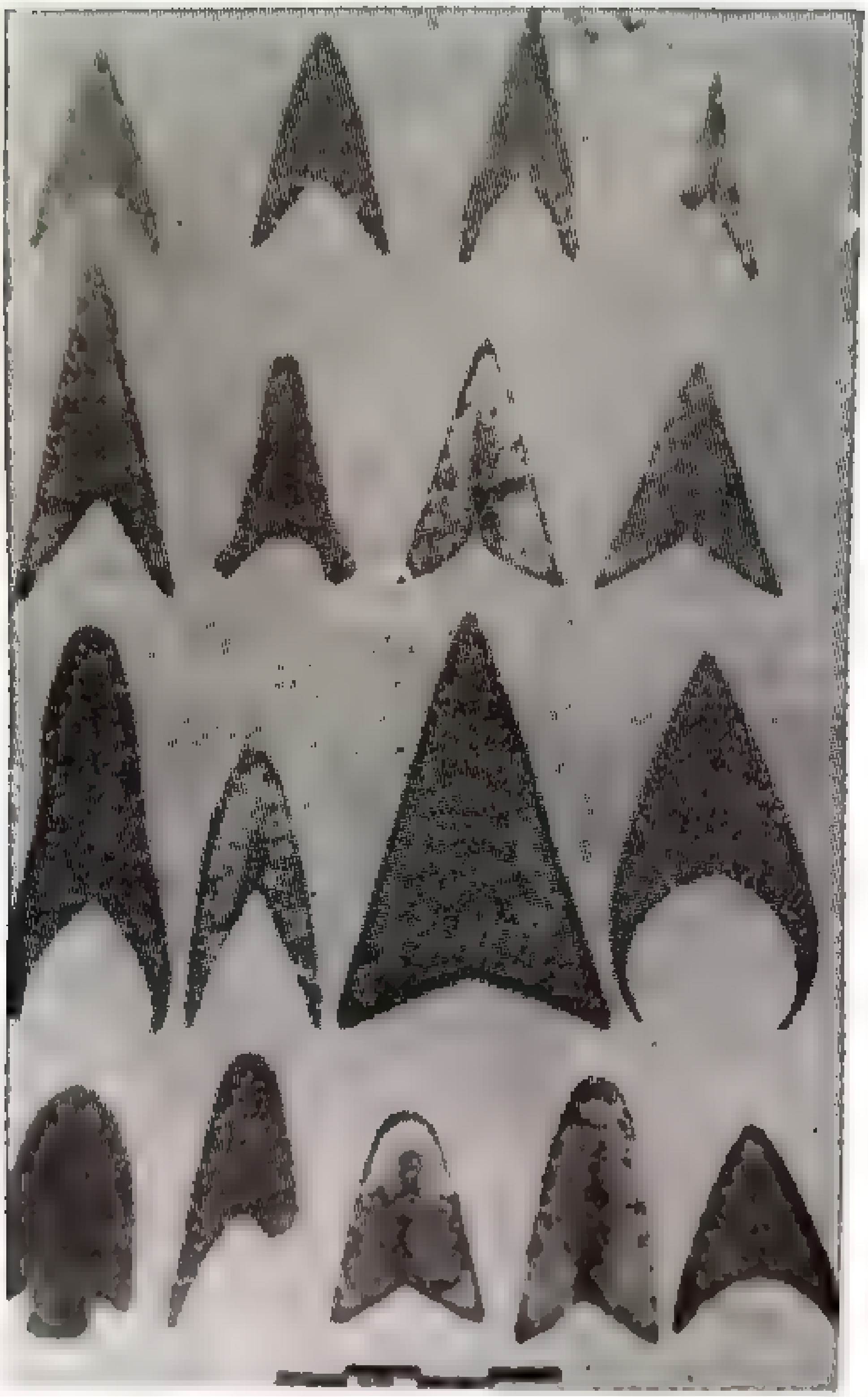


Fig. II : Copper Implements From Ropar IA, IB

Courtesy : Harappan Civilization A Contemporary Perspective.

Plate. 6



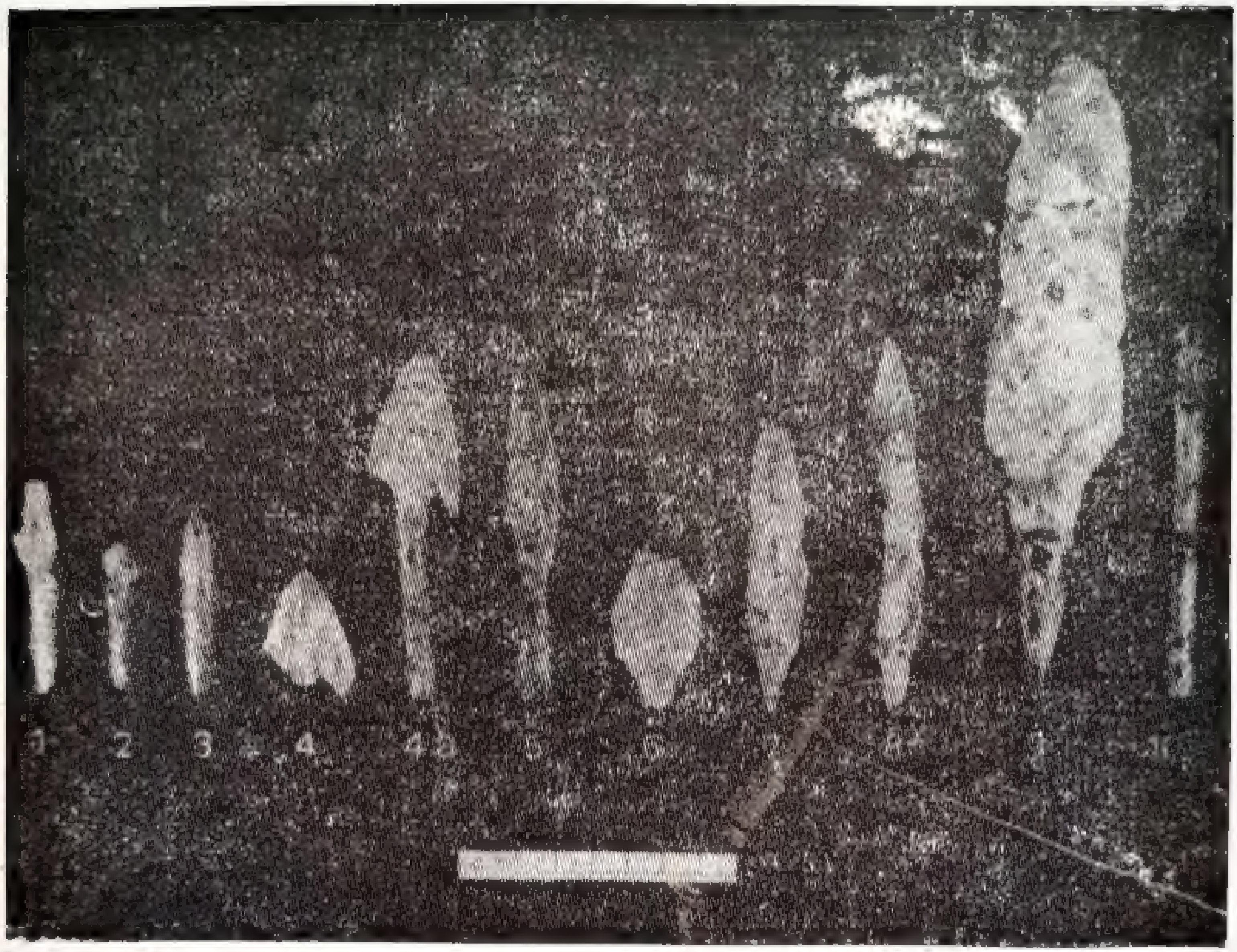
Copper Arrowheads From Ganeshwar
OCP

Courtesy : Harappan Civilization A Contemporary
Perspective.

Plate 7

Copper Fish Hooks From Ganeshwar
OCP Complex
Courtesy : Harappan Civilization A Contemporary Perspective.

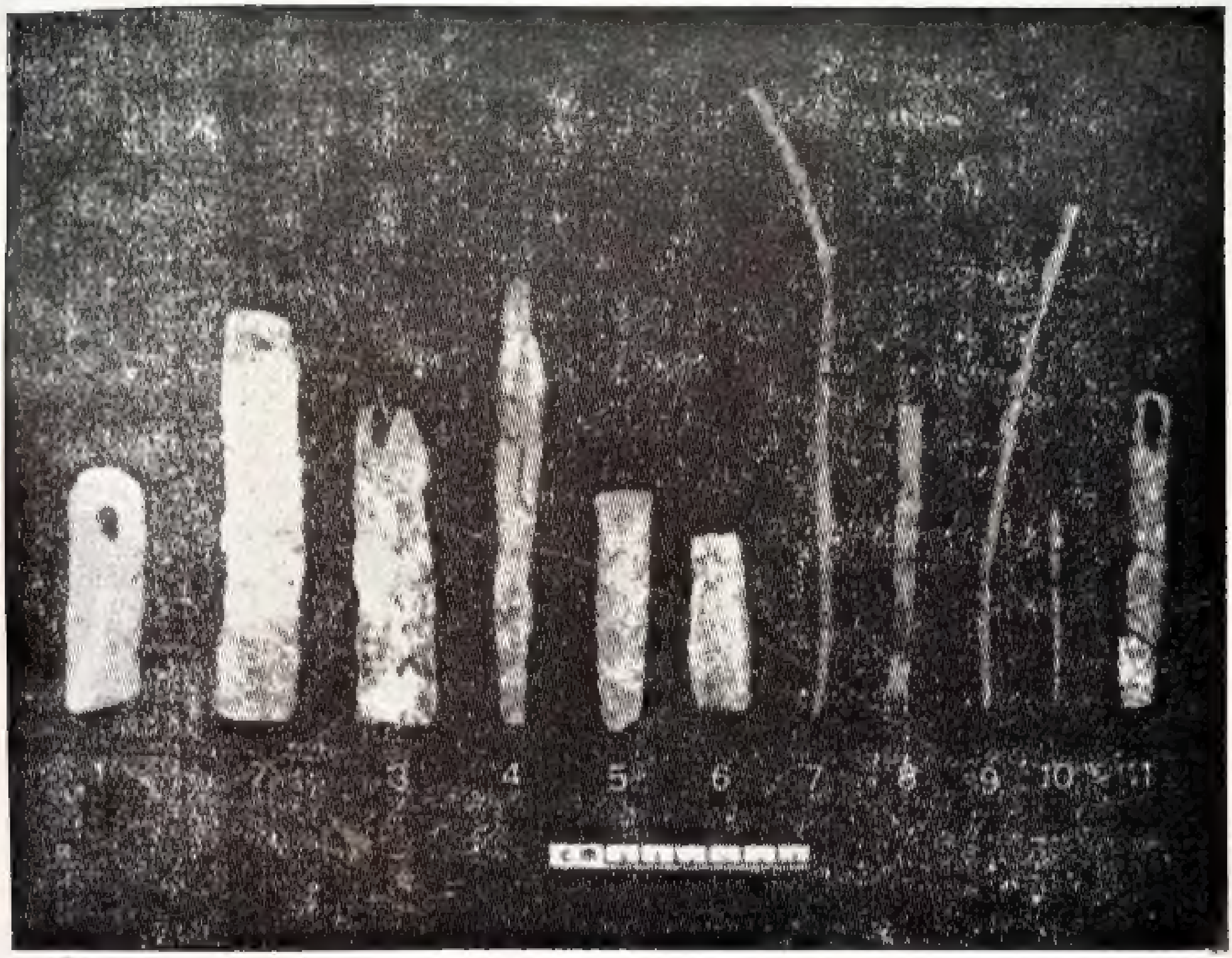
Plate. 8



Iron Objects From PGW Period, Atranji Khera.

Courtesy : Excavations At Atranji Khera.

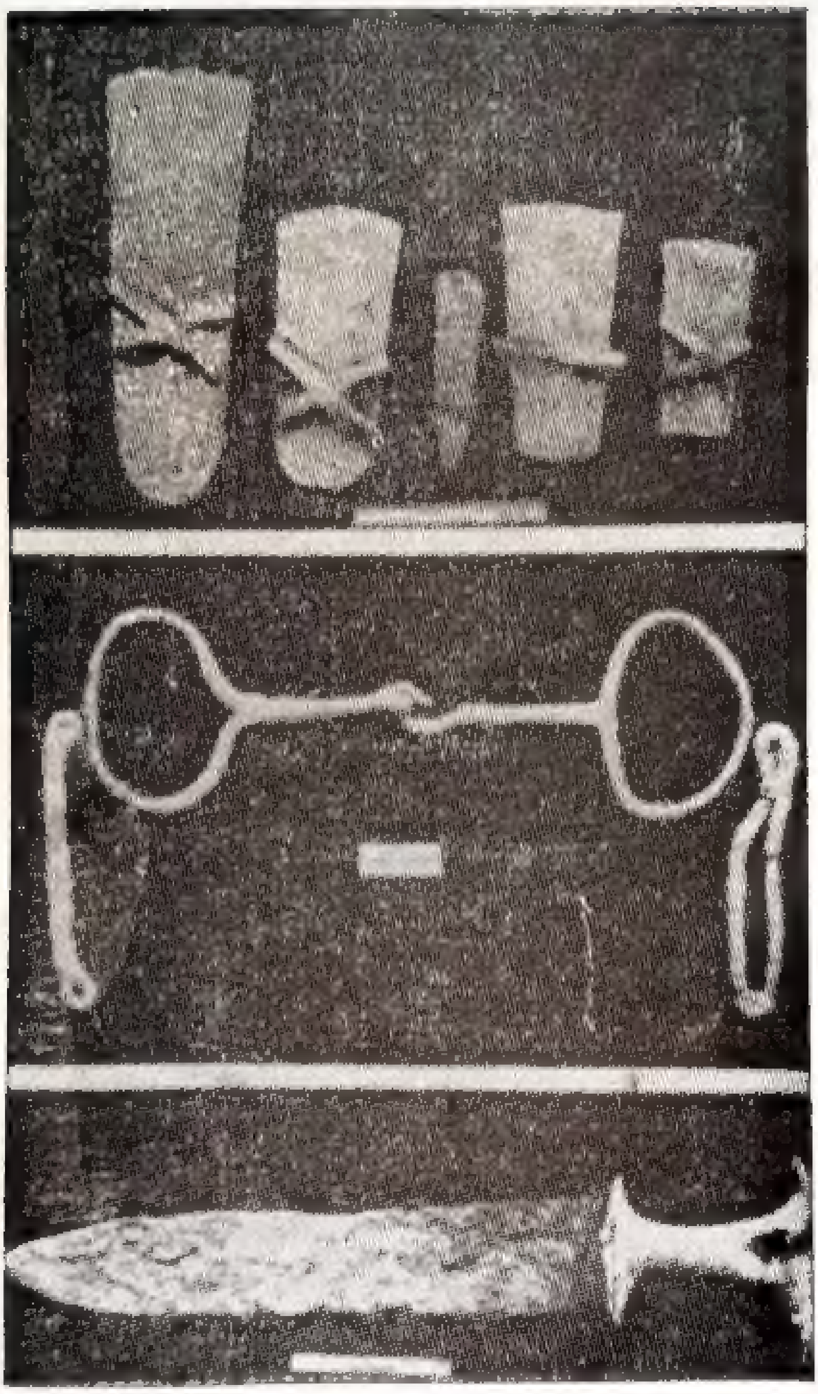
Plate. 9



Iron objects From PGW Period, Atranji Khera.

Courtesy : Excavations At Atranji Khera,

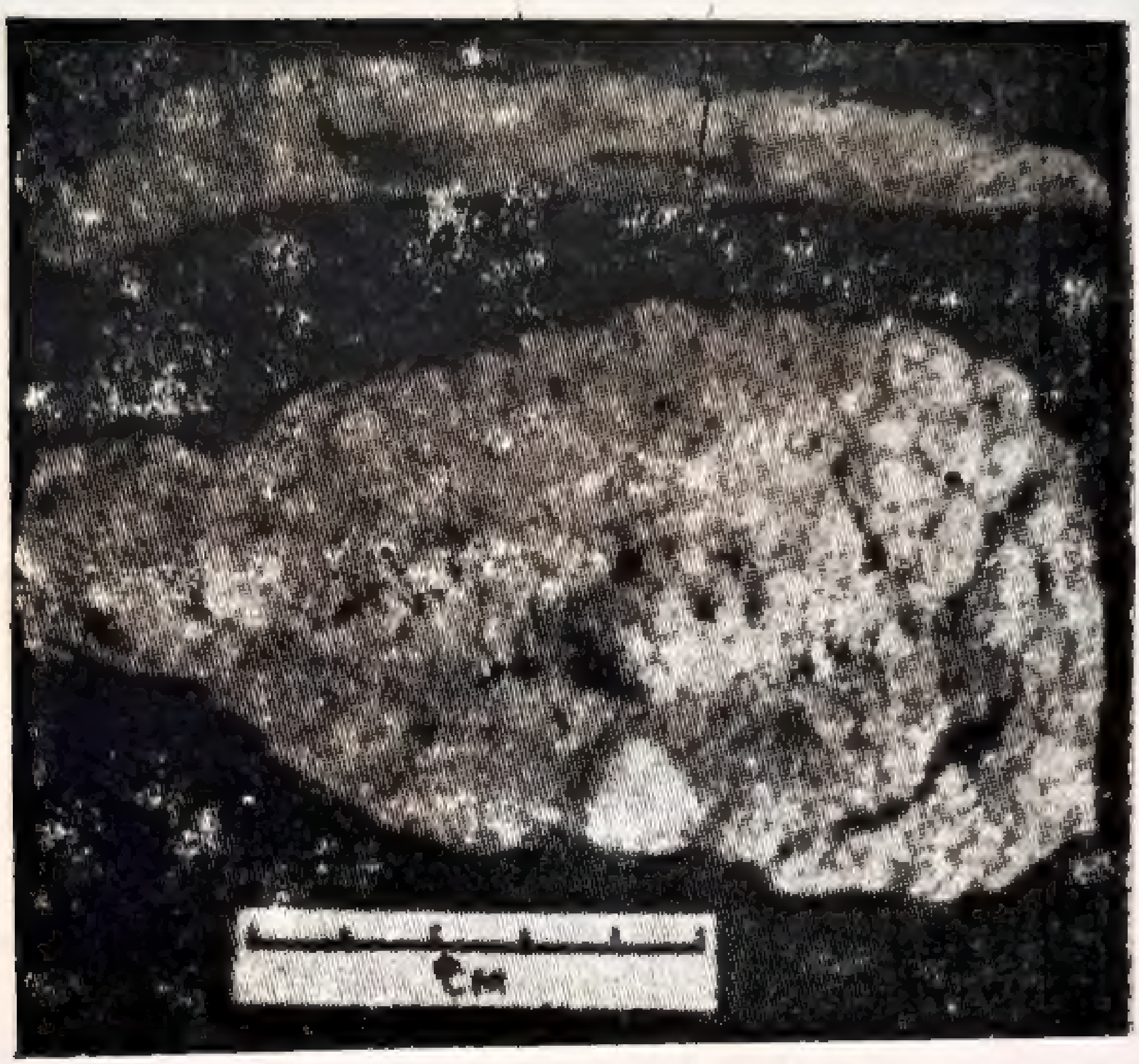
Plate. 10



Iron Objects From Vidarbha Megaliths :
Naikund and Mahurjhari.

Courtesy : Rise of Civilization In India and Pakistan

Plate. 11



Iron Sickle and Axe From Mangalkot,
Pd I, Pd II (Chalcolithic).

Courtesy : Pratnasamiksha—1.